BUILDING A WORLD OF DIFFERENCE®

BLACK & VEATCH

RETI Phase 2 Update Workgroup

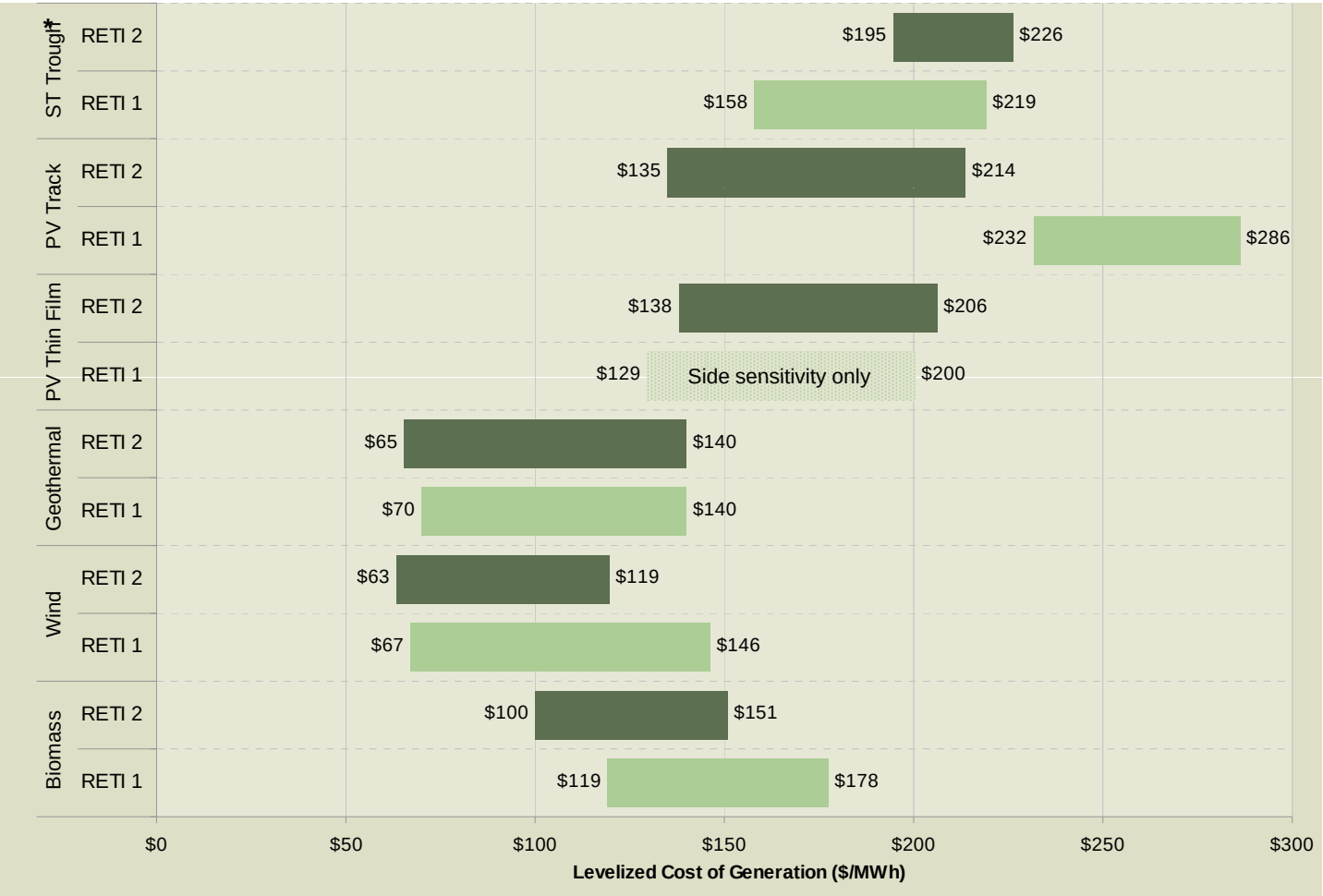
Black & Veatch: Ryan Pletka

December 10, 2009

RETI Phase 2 Update Workgroup Issues

- Economic Model Update ✓
- Extended Analysis of Out-of-State Resources
  - Screening ✓
  - Transmission Approach — Open Issues
- CREZ and Technology Updates
  - CREZ Updates — Open Issues
  - Technology Assumptions ✓
- Net Short Update ✓
- RPS Implementation Timelines — New!

Current RETI Phase 2 Black & Veatch Proposal



***Advanced solar thermal technologies also under consideration**

BUILDING A WORLD OF DIFFERENCE®

BLACK & VEATCH





CREZ Updates

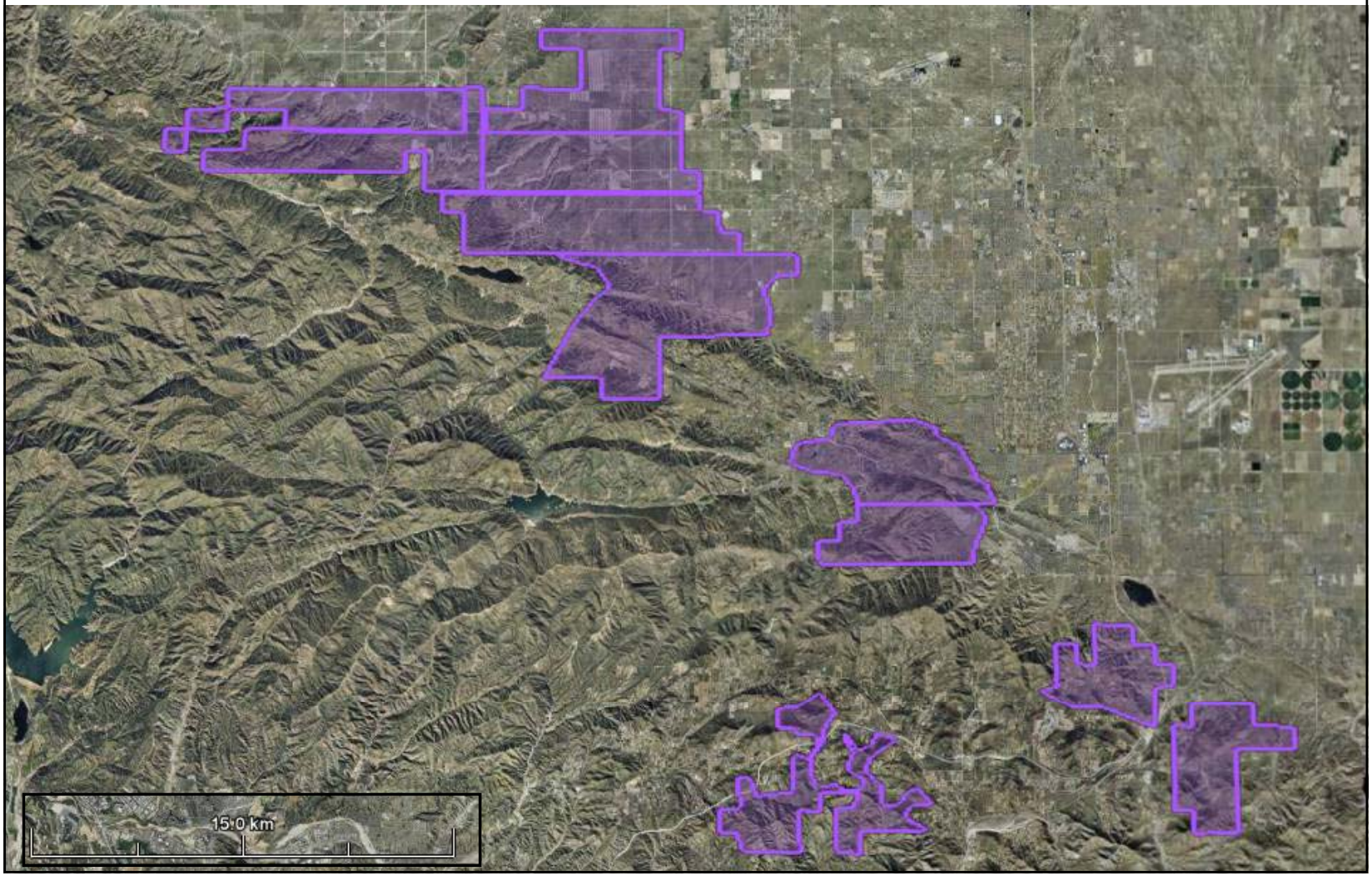
In-State California CREZ Updates from Phase 2A

- Fairmont
- Palm Springs
- Owens Valley
- Westlands Water District

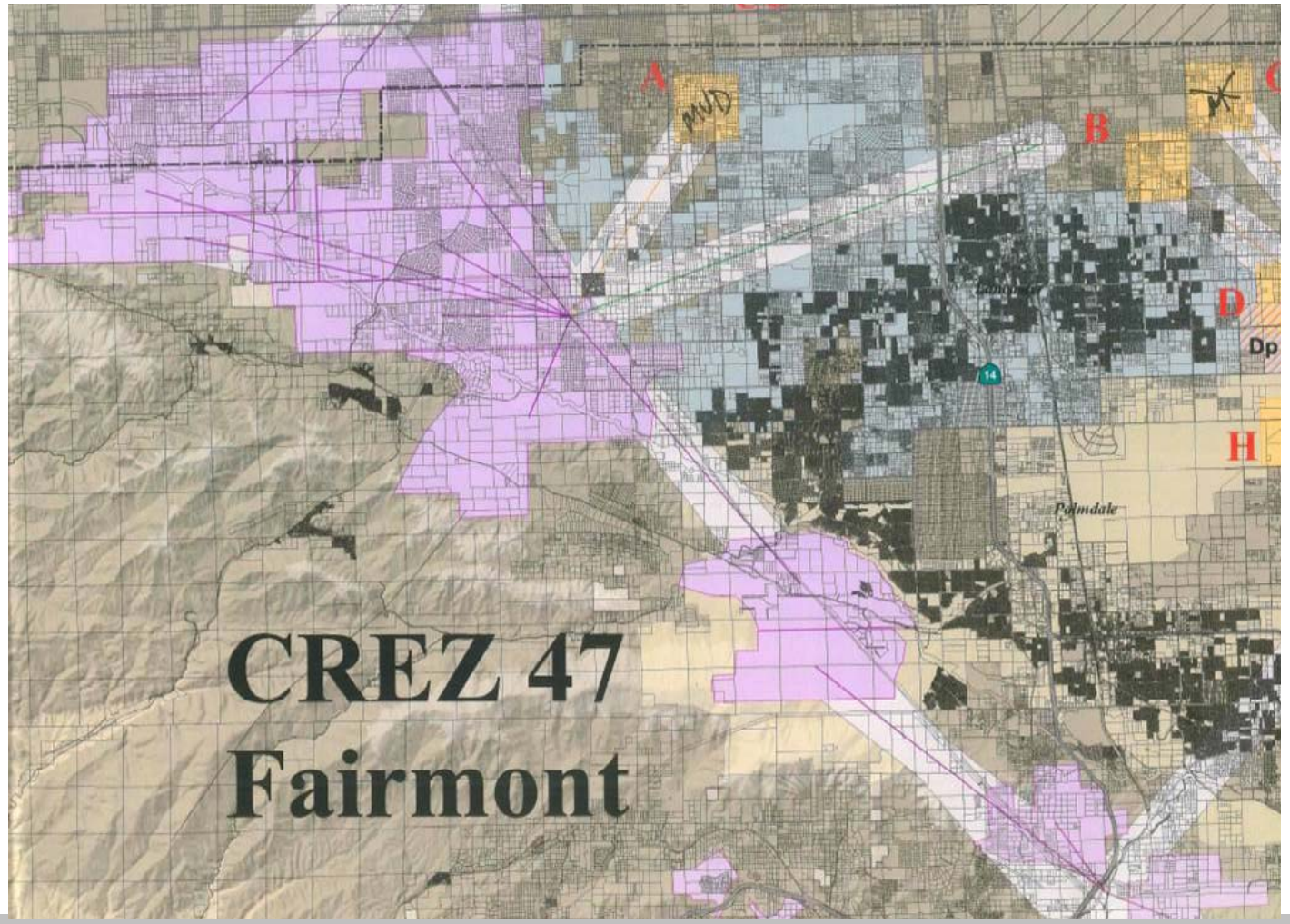
Fairmont CREZ

- Cuts to be based on:
  - Parcelization
  - Suburban encroachment
  - Proximity to poppy reserve

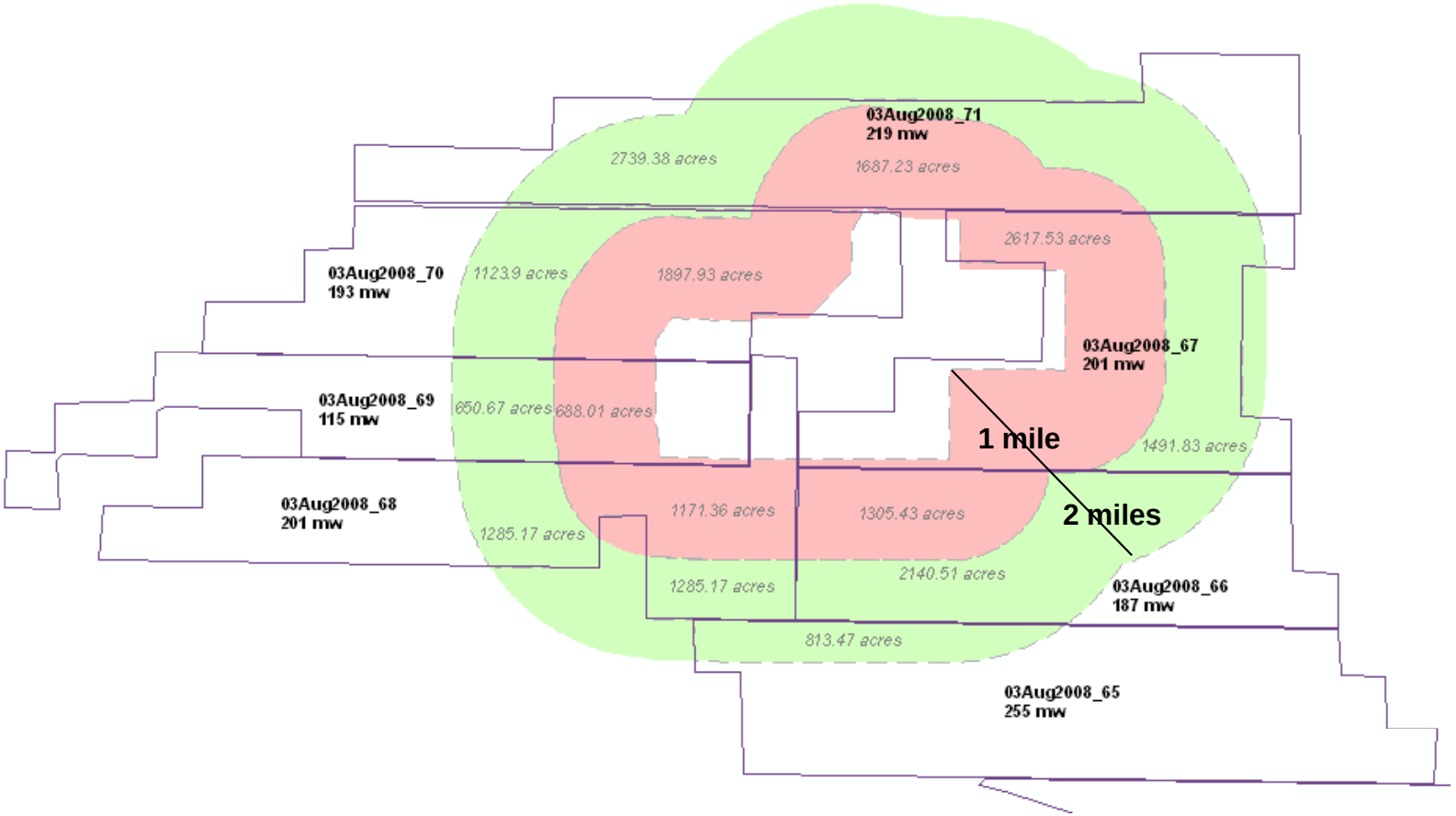
Fairmont CREZ



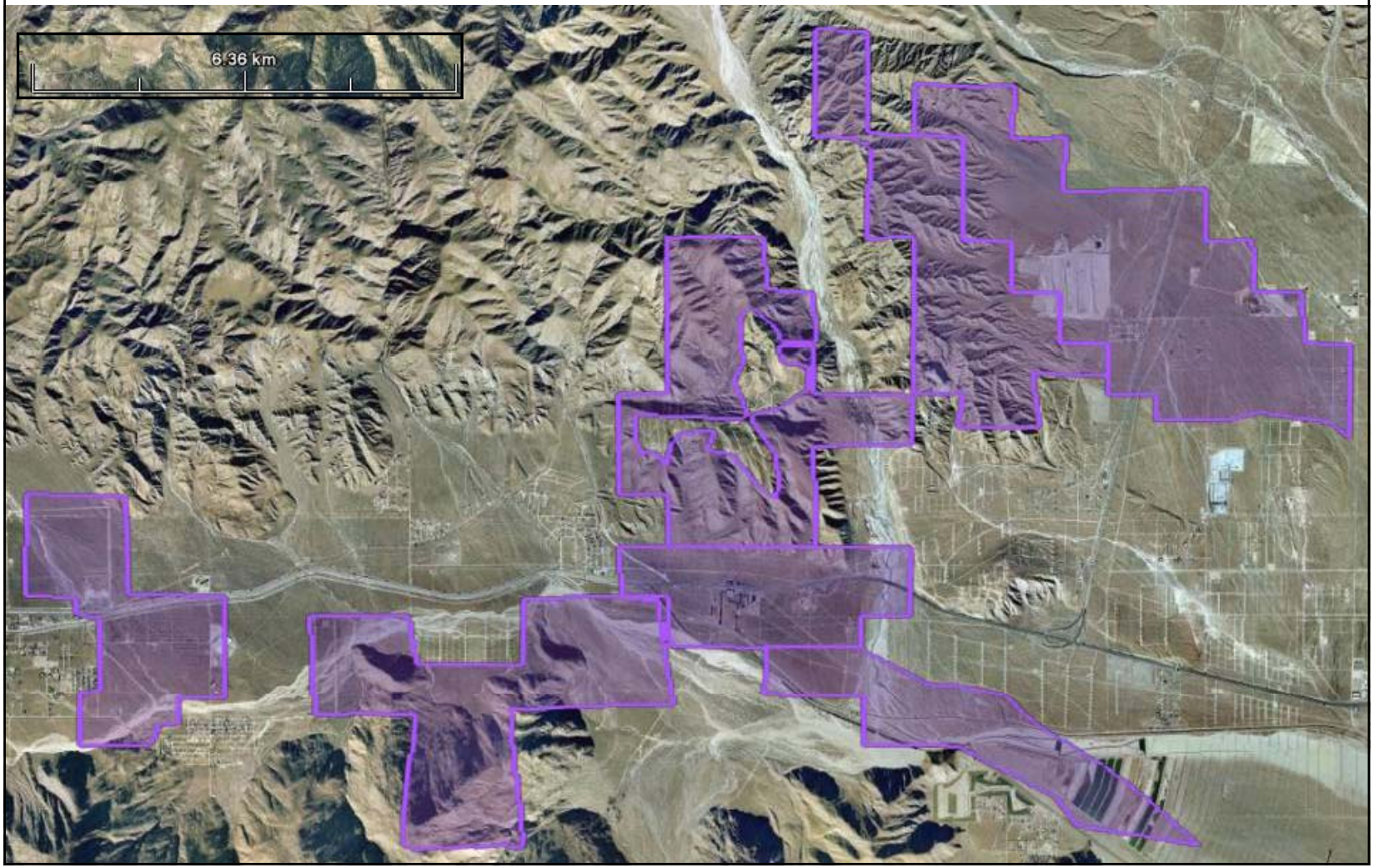
Fairmont Parcelization

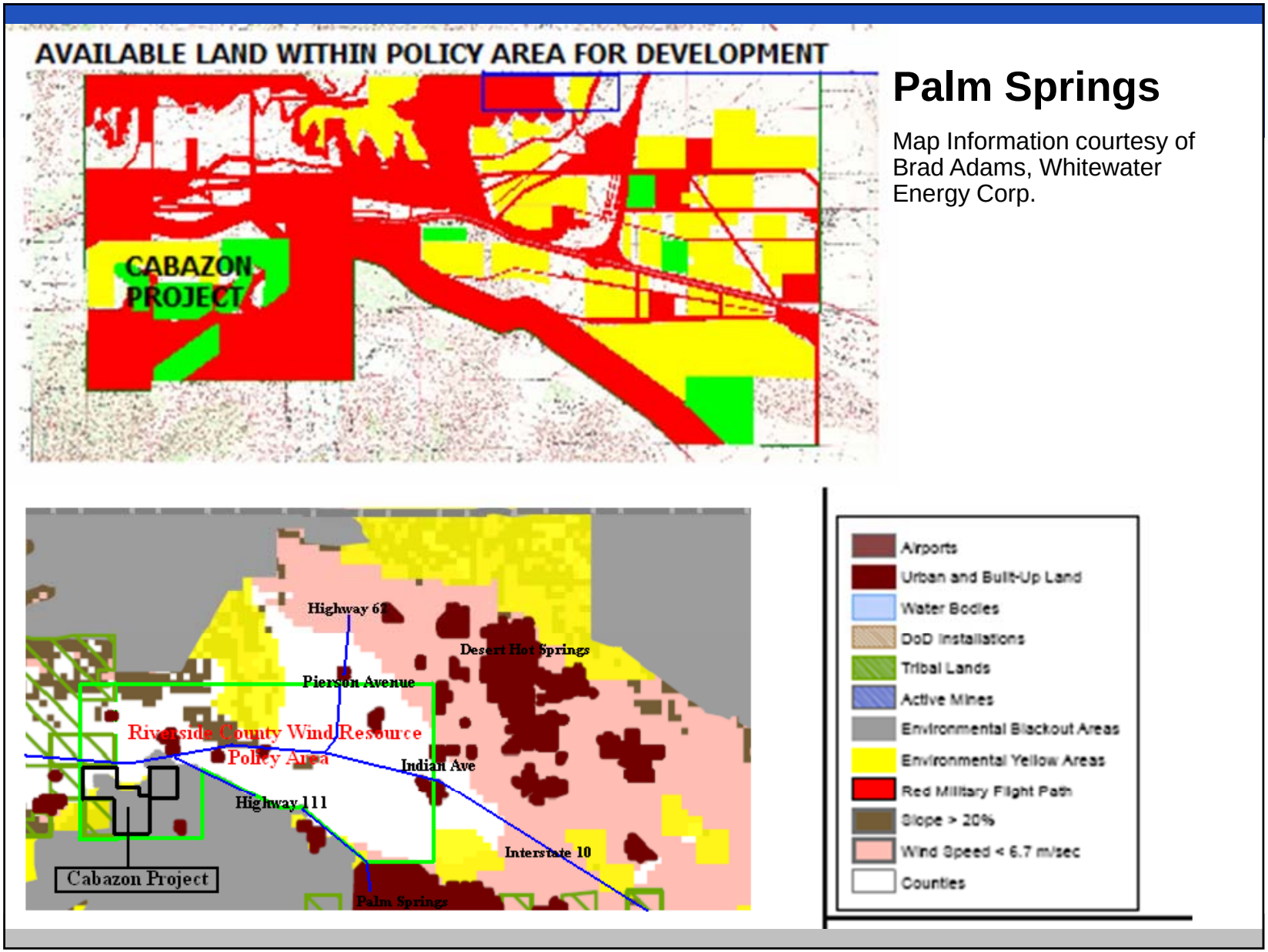


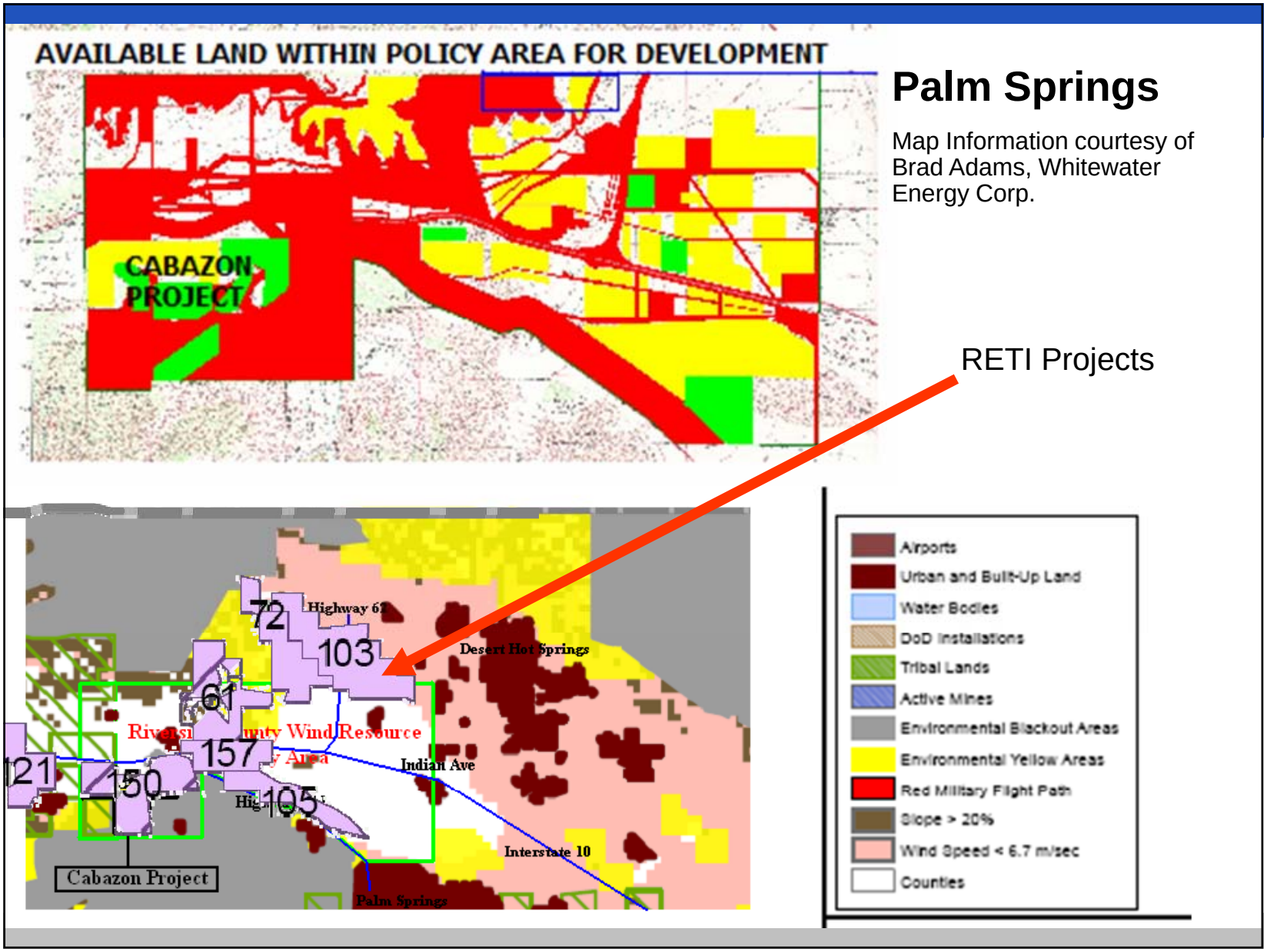
Antelope Valley California Poppy Reserve



Palm Springs Wind Projects

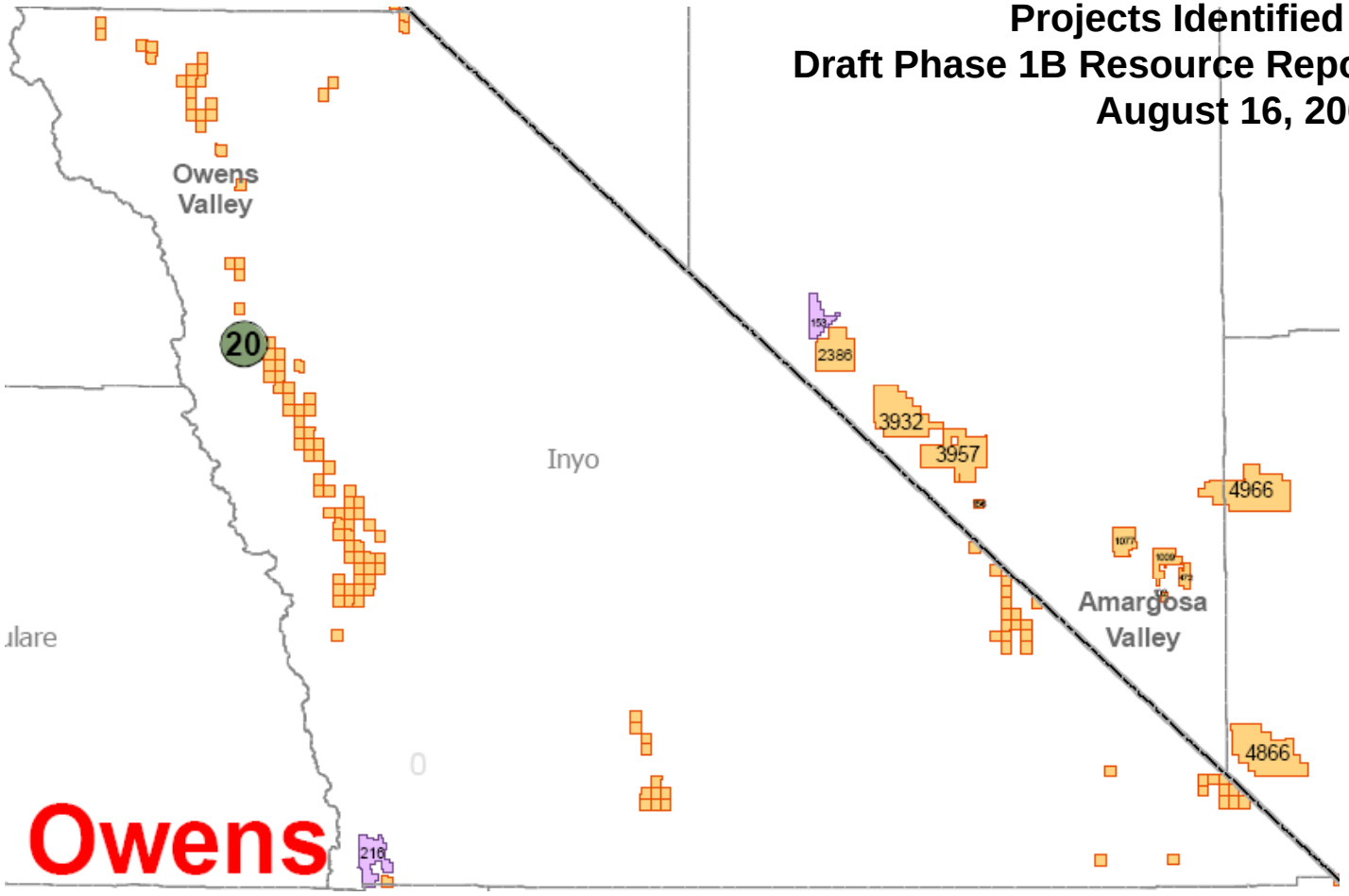



AVAILABLE LAND WITHIN POLICY AREA FOR DEVELOPMENT
CABAZON PROJECT
Palm Springs
Map Information courtesy of Brad Adams, Whitewater Energy Corp.
Highway 62
Desert Hot Springs
Pierson Avenue
Riverside County Wind Resource Policy Area
Indian Ave
Highway 111
Interstate 10
Cabazon Project
Palm Springs
Airports
Urban and Built-Up Land
Water Bodies
DoD Installations
Tribal Lands
Active Mines
Environmental Blackout Areas
Environmental Yellow Areas
Red Military Flight Path
Slope > 20%
Wind Speed < 6.7 m/sec
Counties


AVAILABLE LAND WITHIN POLICY AREA FOR DEVELOPMENT
CABAZON PROJECT
Palm Springs
Map Information courtesy of Brad Adams, Whitewater Energy Corp.
RETI Projects
72
Highway 62
103
Desert Hot Springs
61
157
Indian Ave
121
150
105
Interstate 10
Cabazon Project
Palm Springs
Airports
Urban and Built-Up Land
Water Bodies
DoD Installations
Tribal Lands
Active Mines
Environmental Blackout Areas
Environmental Yellow Areas
Red Military Flight Path
Slope > 20%
Wind Speed < 6.7 m/sec
Counties

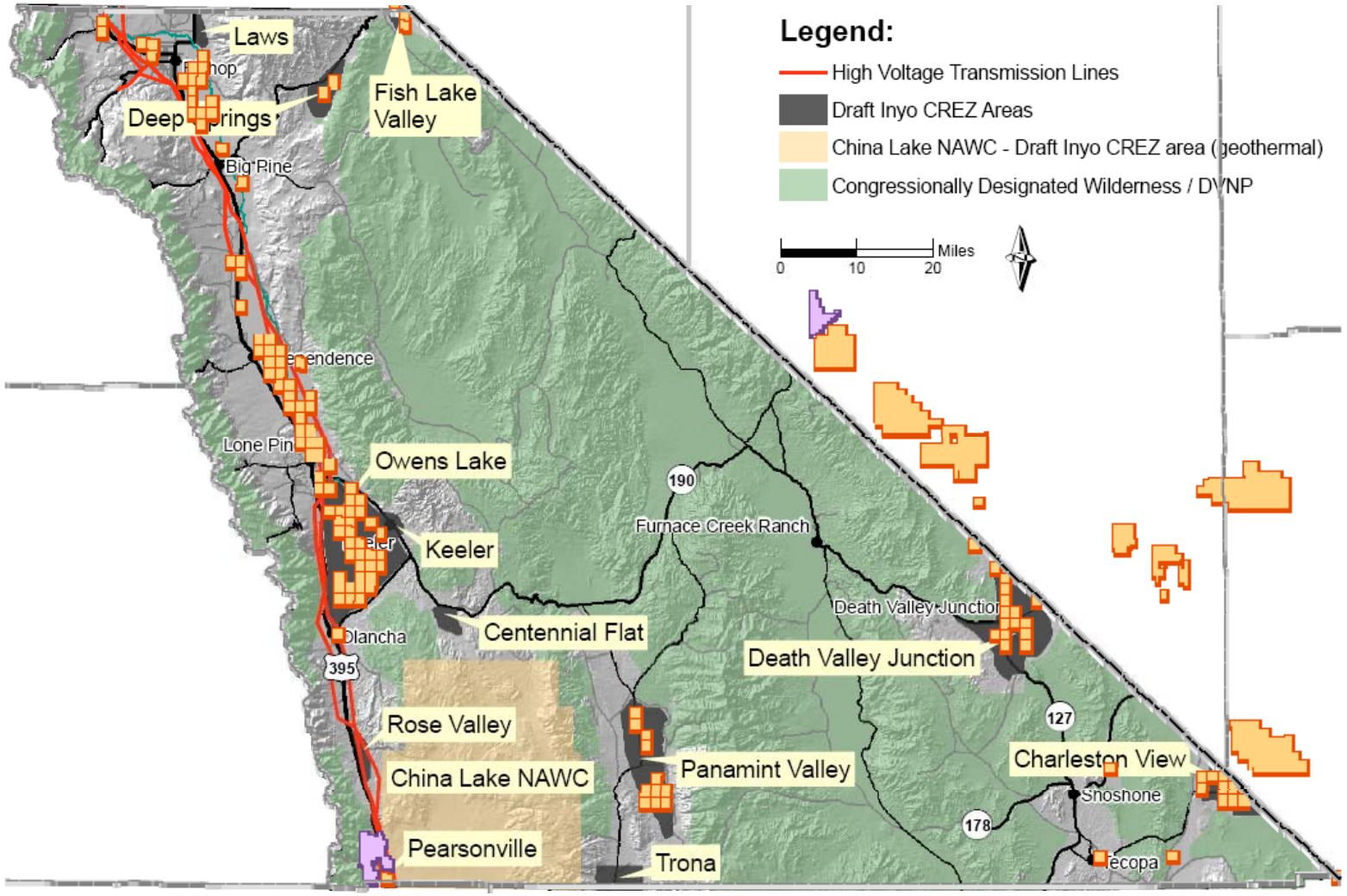
Inyo County

Projects Identified in
Draft Phase 1B Resource Report
August 16, 2008



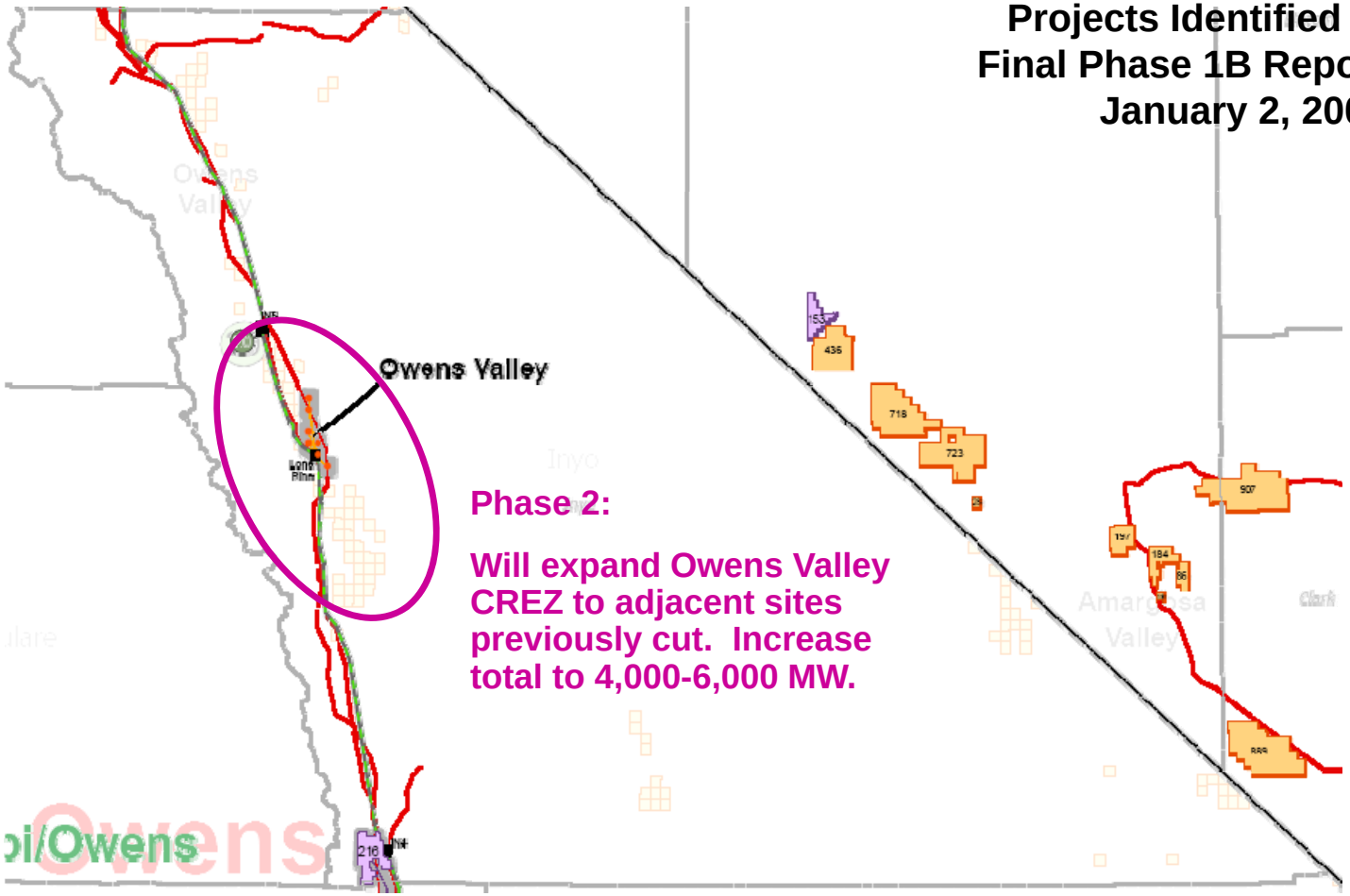
BUILDING A WORLD OF DIFFERENCE®

BLACK & VEATCH

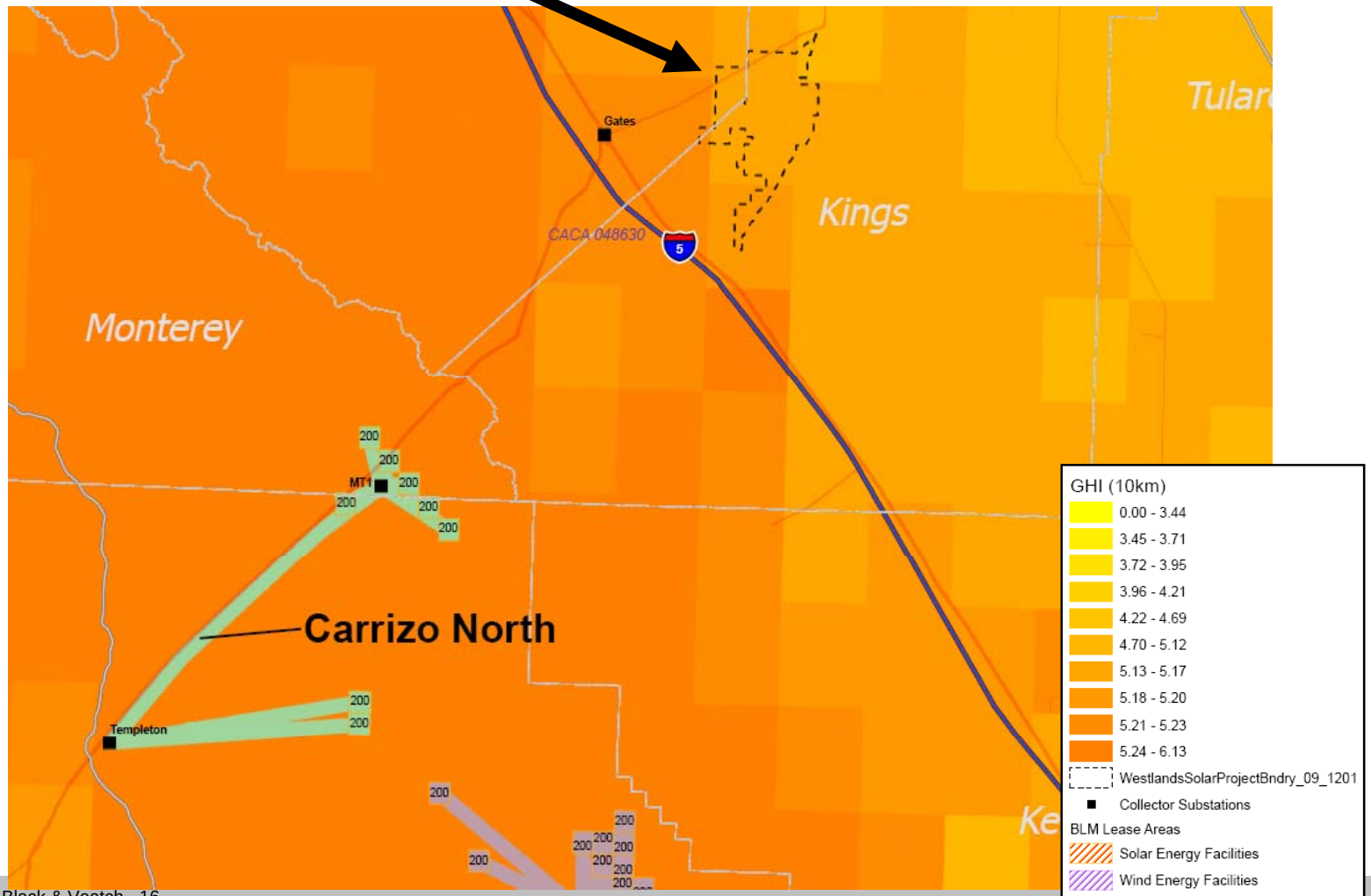


Inyo County

Projects Identified in Final Phase 1B Report January 2, 2009



Westlands Water District (up to 3000-5000 MW)







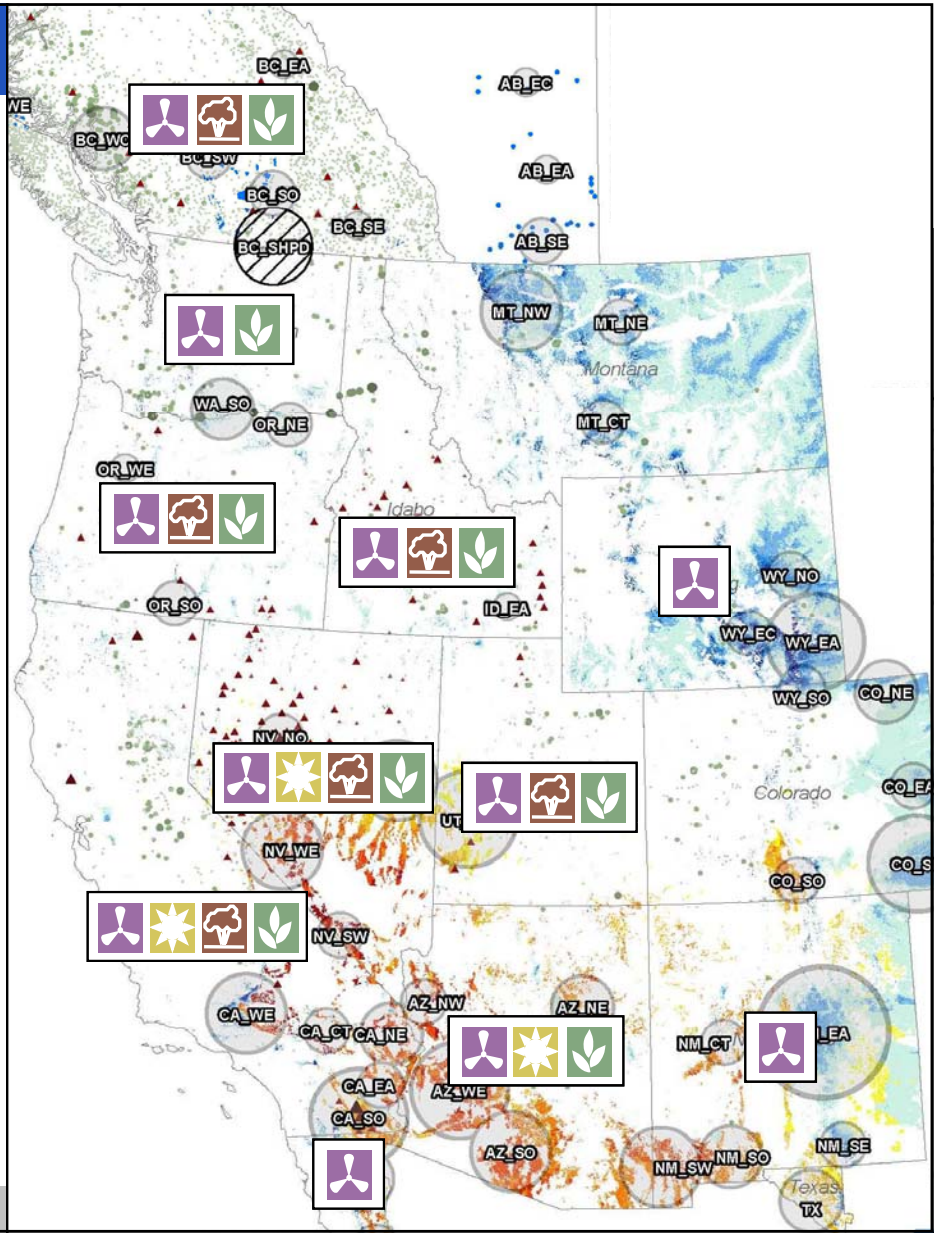
Transmission

Transmission Cost Approach

- Out-of-state resources
  - 500 kV single-circuit ac transmission, 1500 MW capacity, $1.8 million/mile, federally financed, delivered to "gateway CREZs" (e.g., Mountain Pass)
    - From WREZ Transmission Characteristics Working Group
  - Open issue: Line utilization
- In-state transmission costs:
  - Include all costs for 2A Collector Lines; allocation based on 2A shift factors
  - Include 50% of the 2A Foundation and Delivery Line costs; allocation based on 2A shift factors
  - Use 2A costs, annualized with 10% fixed charge rate

BUILDING A WORLD OF DIFFERENCE®

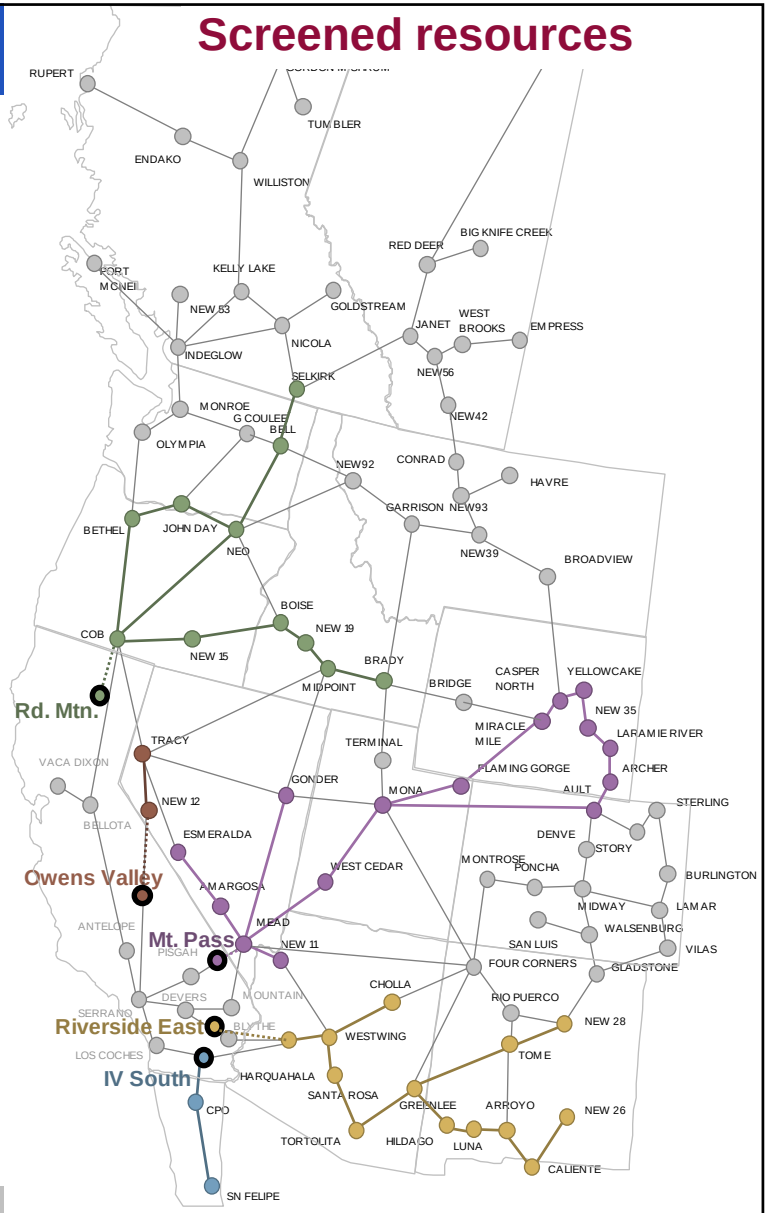
Resources to be Considered in RETI Phase 2A Update



BUILDING A WORLD OF DIFFERENCE®

OOS Resources Delivered to California Gateway Substations / CREZs Shift Factors from Phase 2A

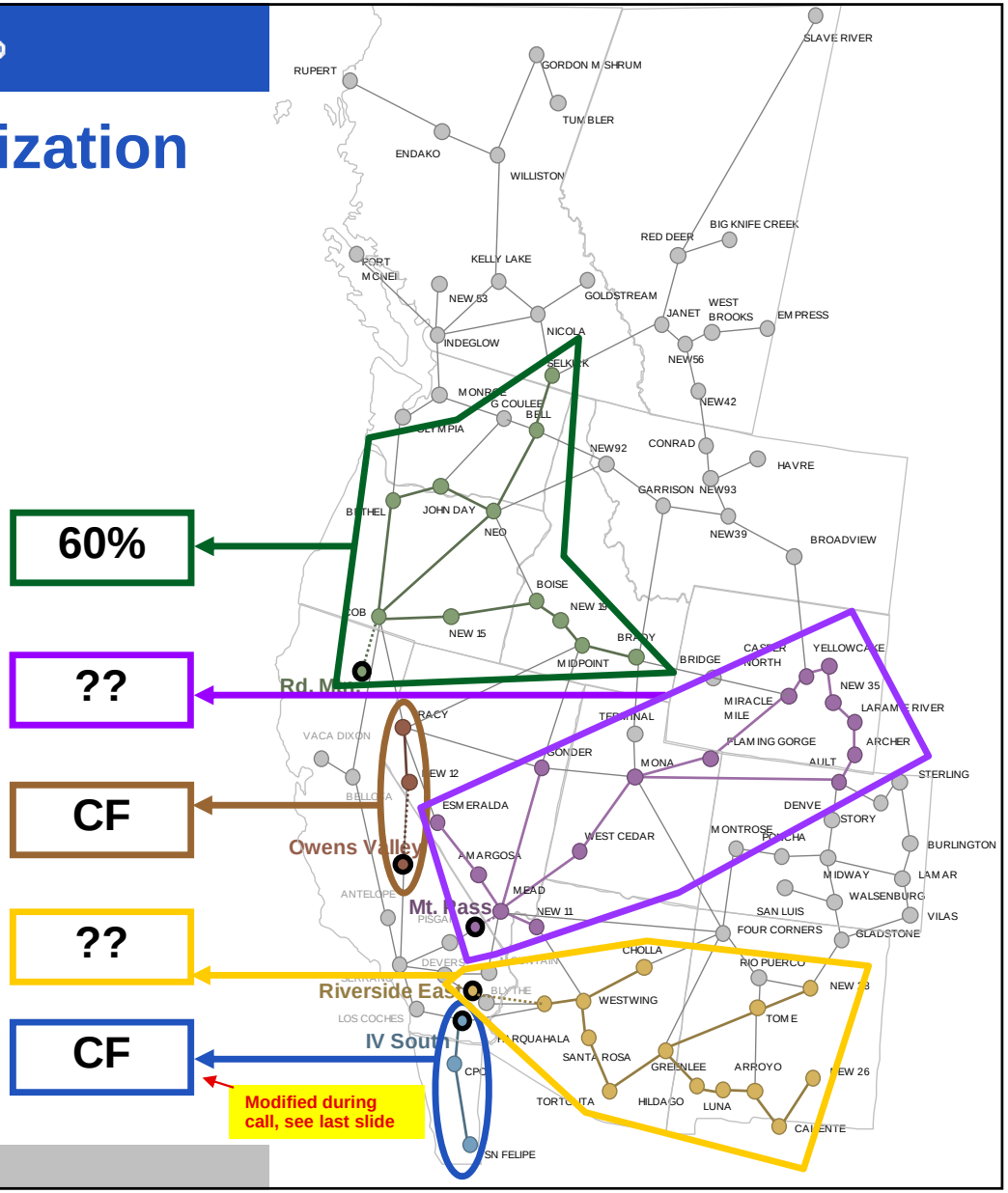
- COB > Round Mountain
- NEW 12 (CA/NV) > Owens Valley
- MEAD > Mt. Pass
- ALAMORIO > Imperial Valley South
- HARQUAHALA > Riverside East



Transmission Utilization

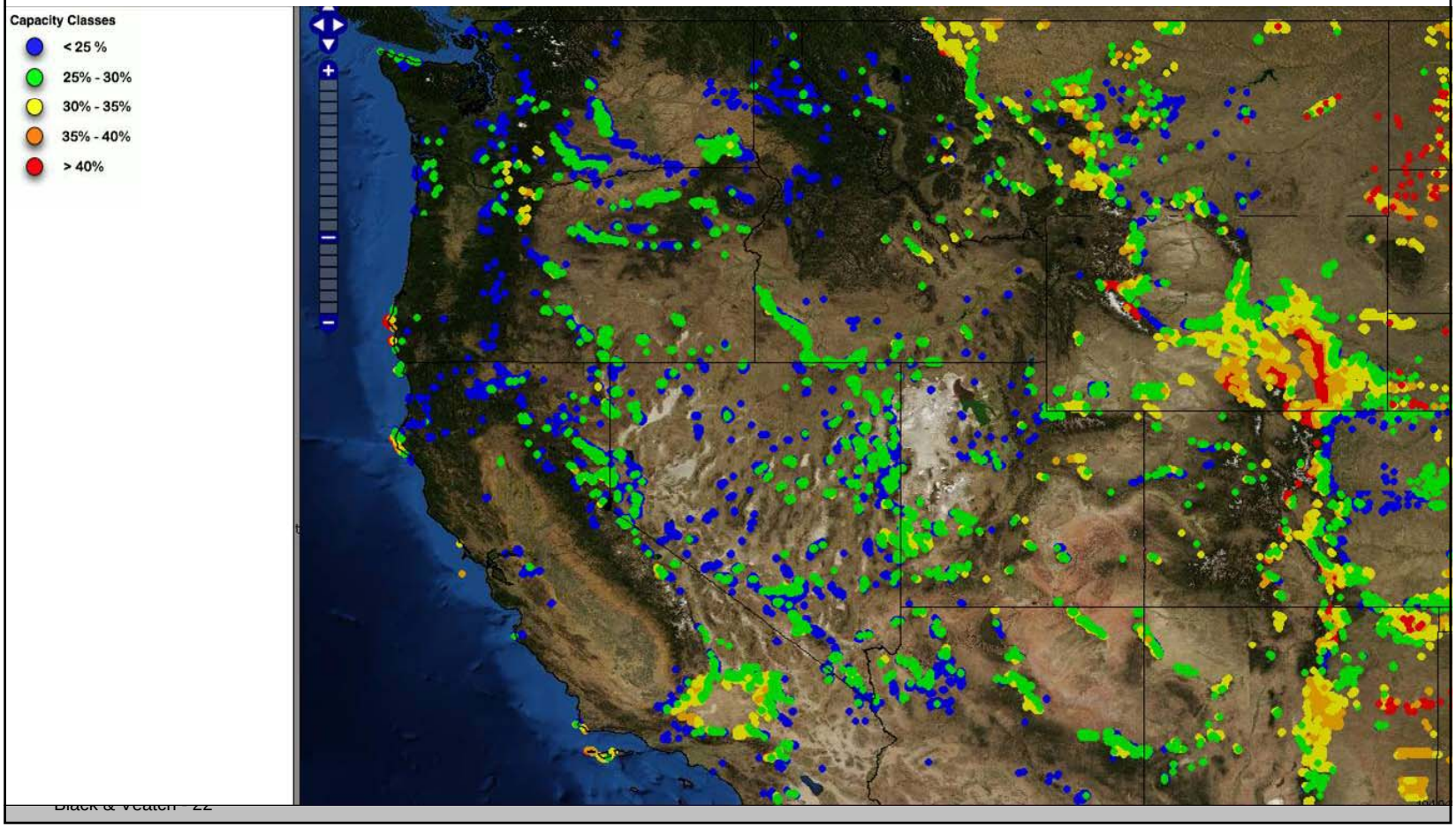
- **Pacific Northwest** has lots of existing transfer, blend of resources (including hydro, biomass, geothermal, wind) → use 60%
- **N. Nevada** is largely geothermal → use resource CF (80-90%)
- **Baja** is all wind → use resource CF

  Modified during call, see last slide
- Performing additional analysis on blended wind and solar dominated resource areas
  - **WY/UT/etc** – predominately wind
  - **AZ/NM** – Mixed wind and solar



Data Source – NREL's Western Wind and Solar Integration Study

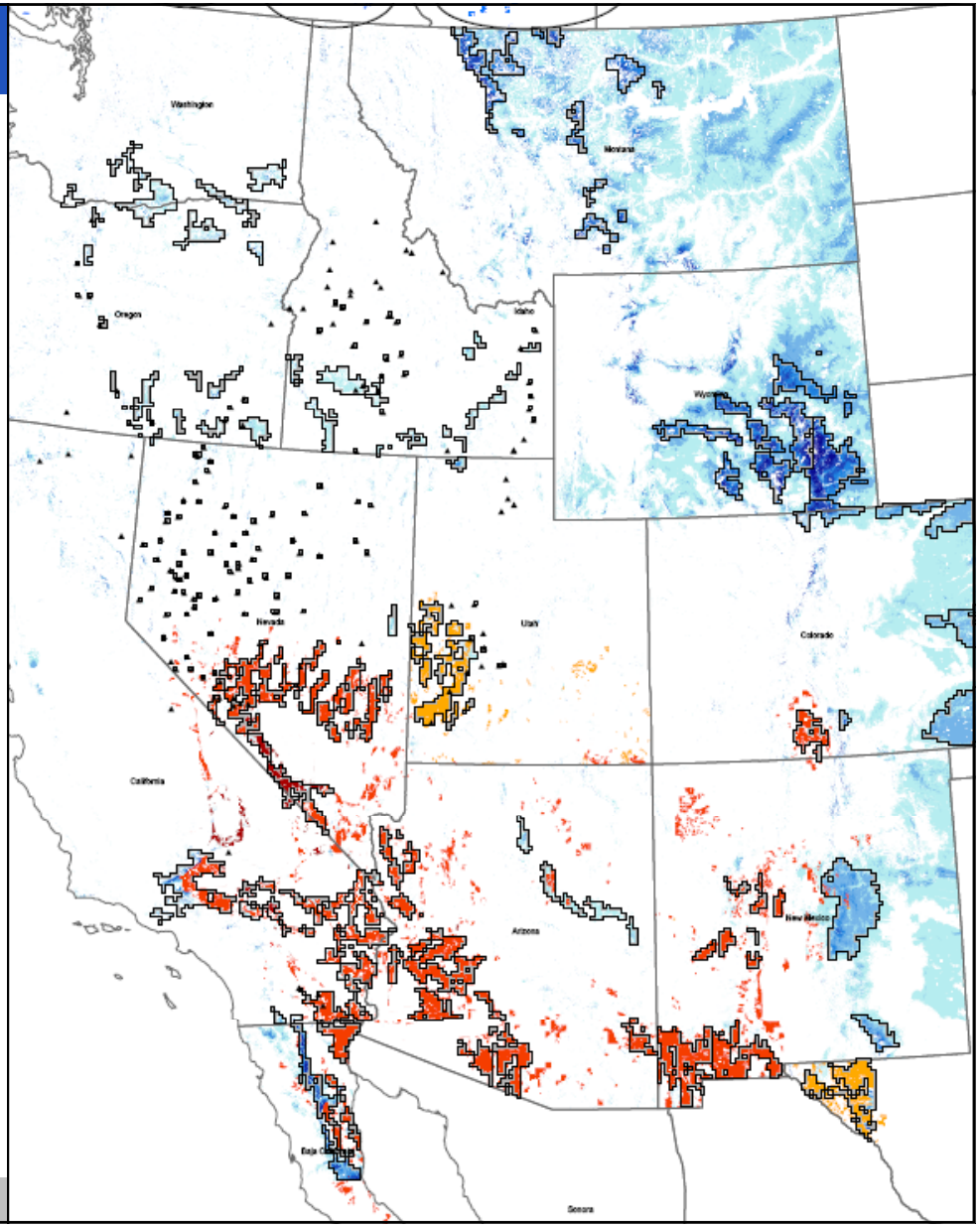
- 10 minute data for thousands of sites from http://mercator.nrel.gov/wwsi/



BUILDING A WORLD OF DIFFERENCE®

Data Regions

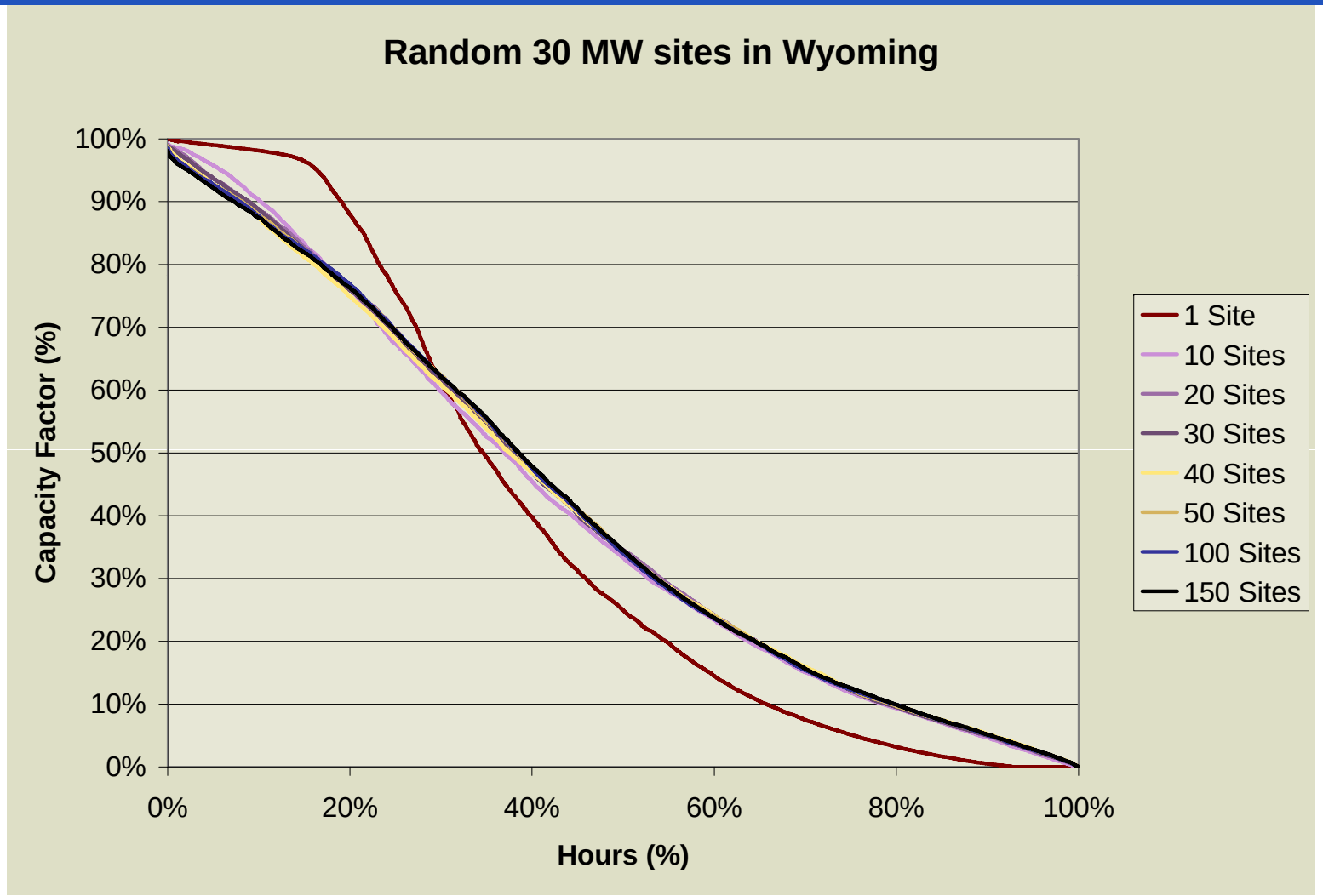
- Aggregated by WREZ QRA region, as outlined in this map
- This is the data currently available for analysis

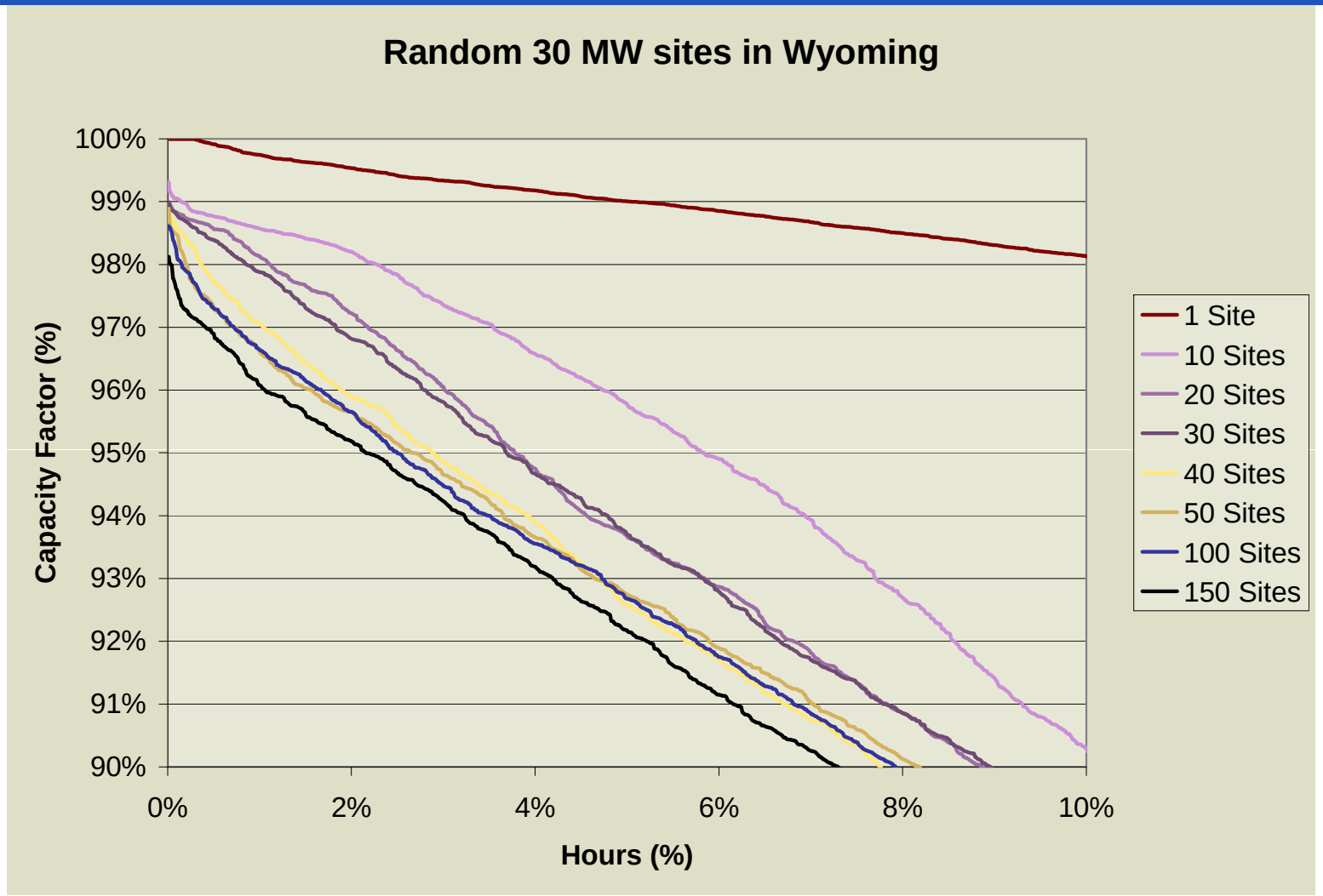


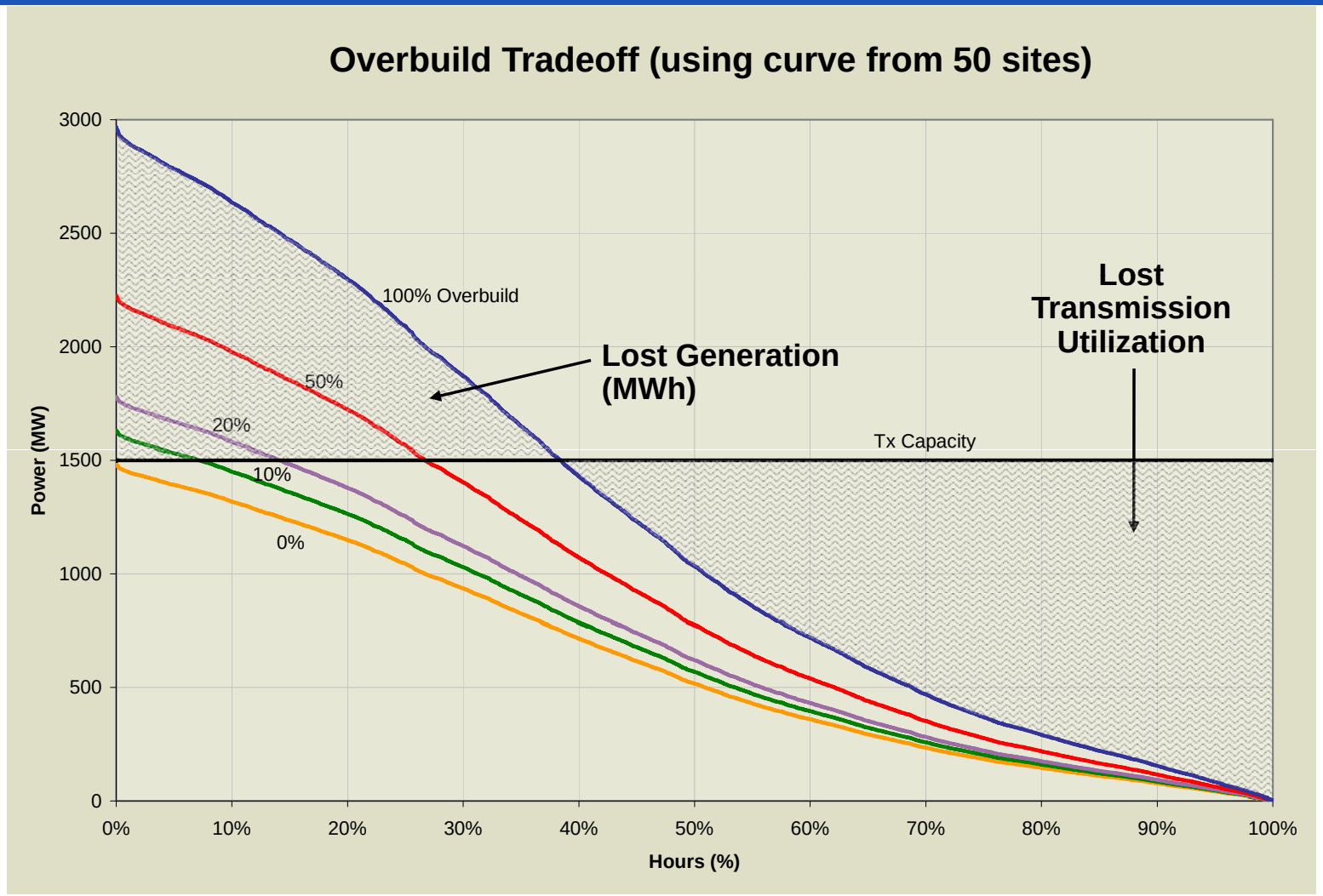
Aggregation and Analysis Process

10 minute site data, MW

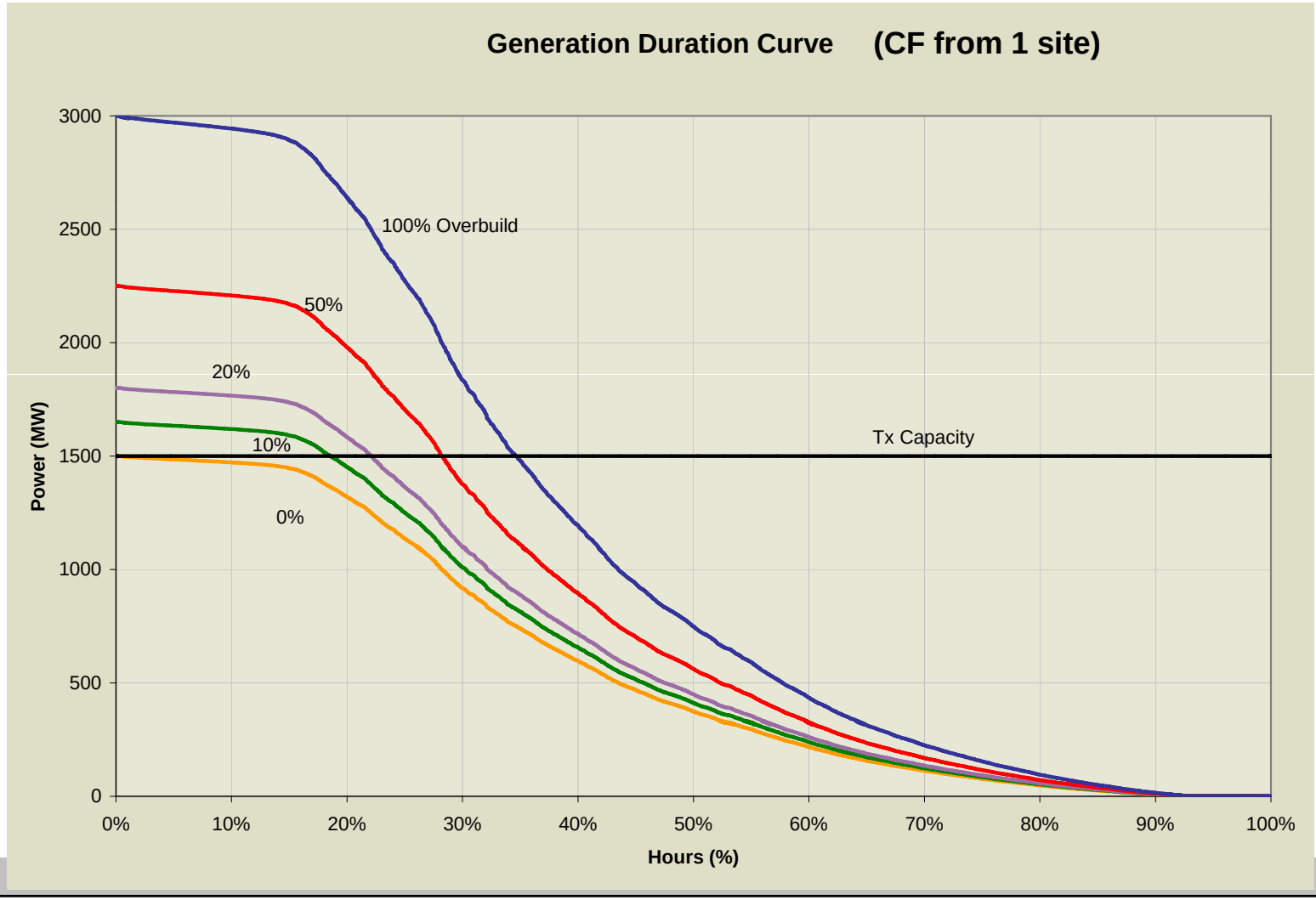
- → Random sites selected, aggregated by QRA or State, over min. specified CF
- → Aggregated into hourly site data, MW, 8760
  - Sorted in Descending order
  - Normalized to CF, based on 30 MW max
  - 8760 hours normalized to % of hours


Random 30 MW sites in Wyoming
Capacity Factor (%)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0%
20%
40%
60%
80%
100%
Hours (%)
1 Site
10 Sites
20 Sites
30 Sites
40 Sites
50 Sites
100 Sites
150 Sites


Random 30 MW sites in Wyoming
100%
99%
98%
97%
96%
95%
94%
93%
92%
91%
90%
Capacity Factor (%)
0%
2%
4%
6%
8%
10%
Hours (%)
1 Site
10 Sites
20 Sites
30 Sites
40 Sites
50 Sites
100 Sites
150 Sites


Overbuild Tradeoff (using curve from 50 sites)
Power (MW)
3000
2500
2000
1500
1000
500
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Hours (%)
100% Overbuild
50%
20%
10%
0%
Lost Generation (MWh)
Tx Capacity
Lost Transmission Utilization

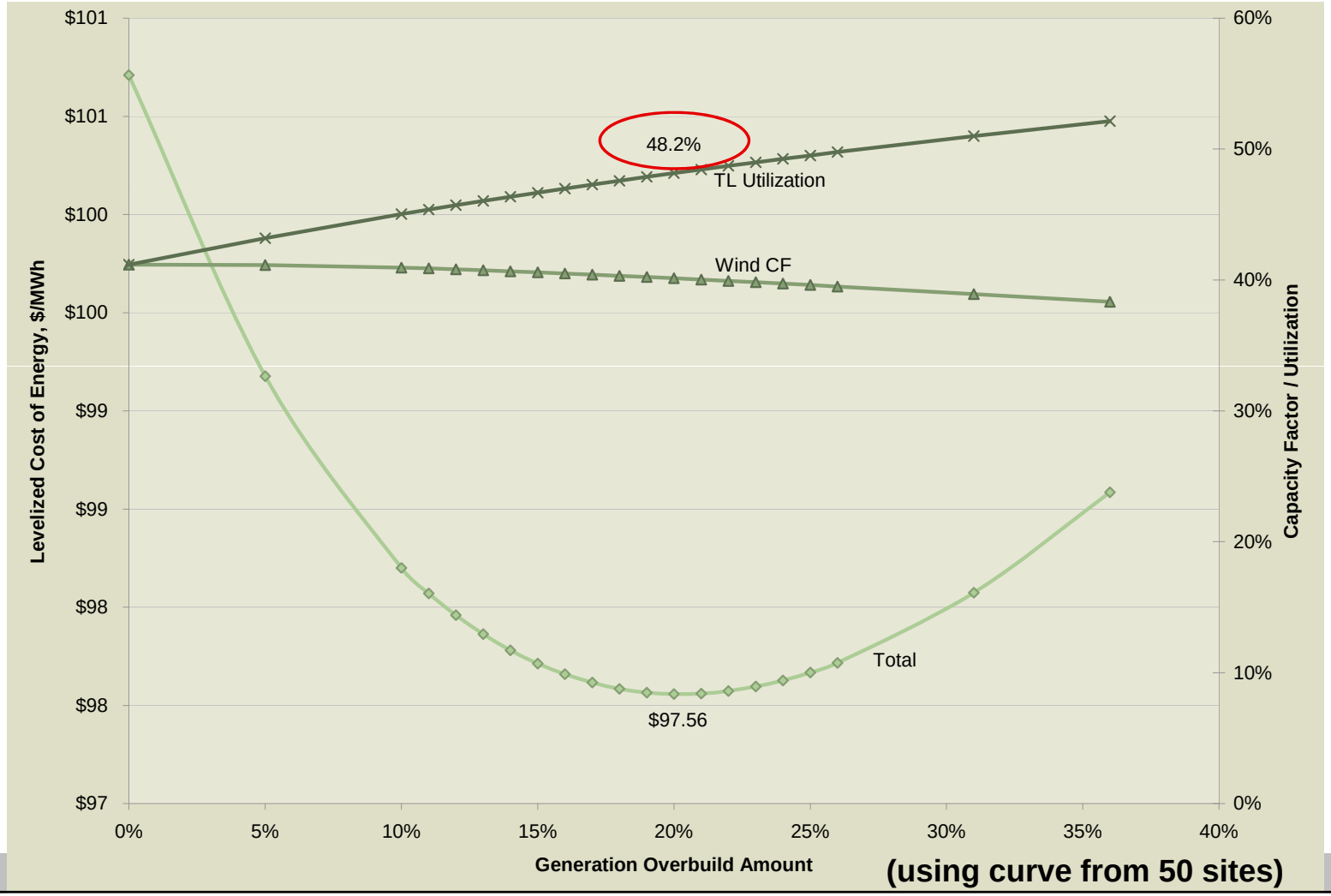
Shape for a single site (no mitigation of variability) is very different



Total Cost

- Generation Cost Increases as Capacity Factor Decreases
- Transmission Cost Decreases as Line Utilization Increases

Transmission Utilization at Optimal Overbuild (Cost-based)



(using curve from 50 sites)

Rank Cost = Adjusted Delivered Cost

Rank Cost = Adjusted Delivered Cost = Generation Cost + Transmission Cost – Energy Value – Capacity Value

Wyoming Wind

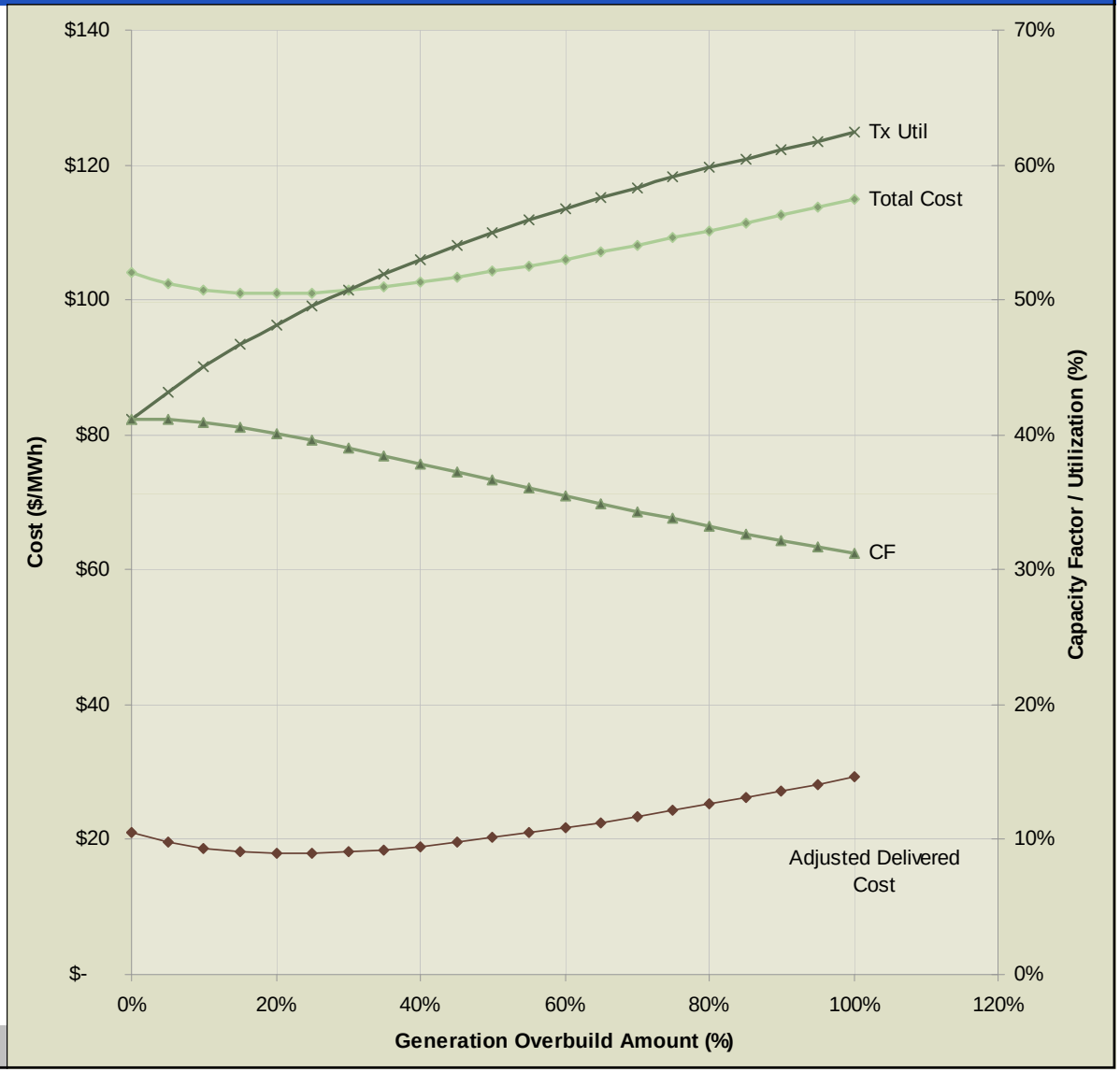
Optimum

Overbuild: 20%

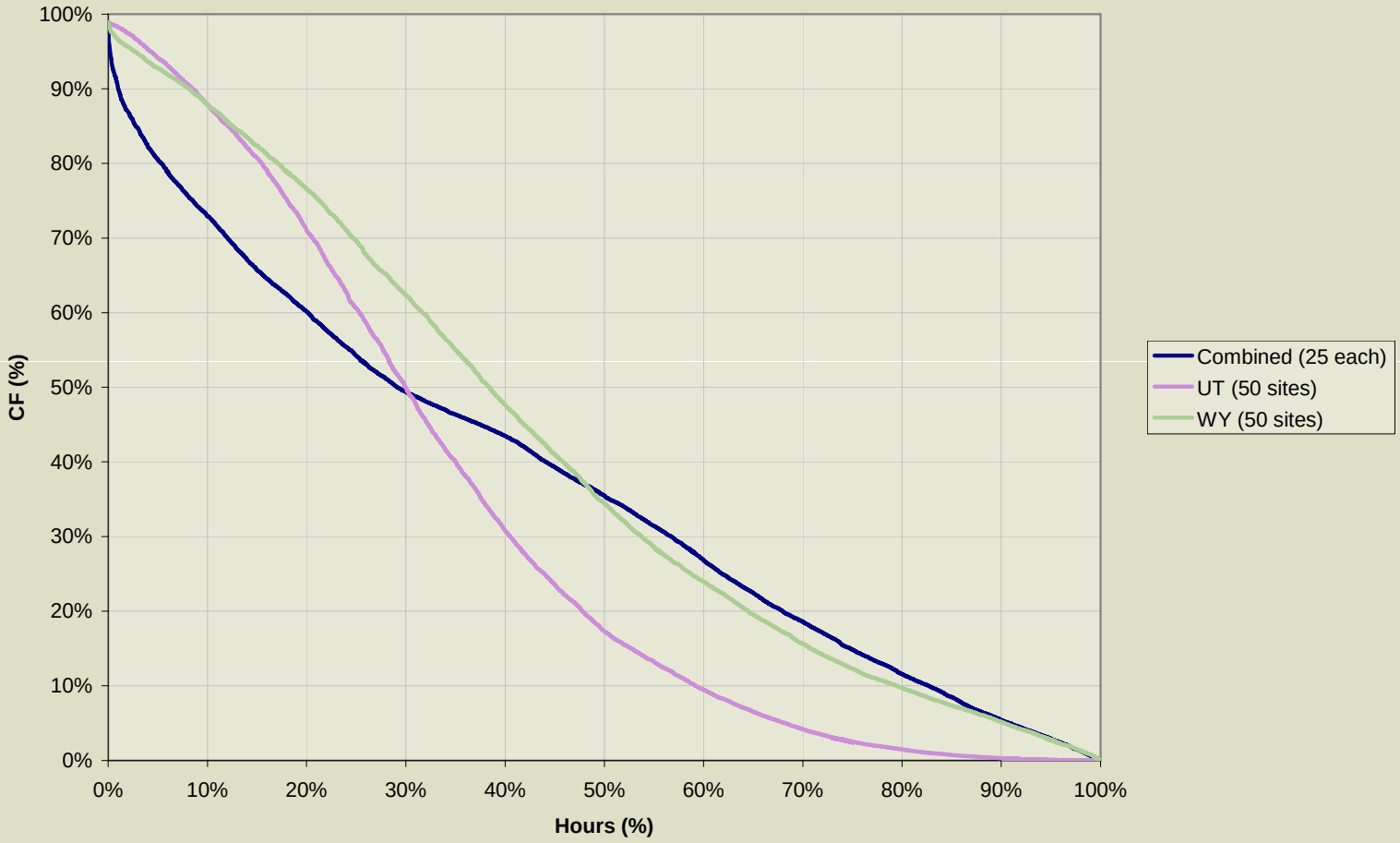
LCOE: $100.92

Adjusted Cost: $17.88

Tx Utilization: 48.2%



Combined Generation Duration Curve (50% Each by MW)



Utah Wind

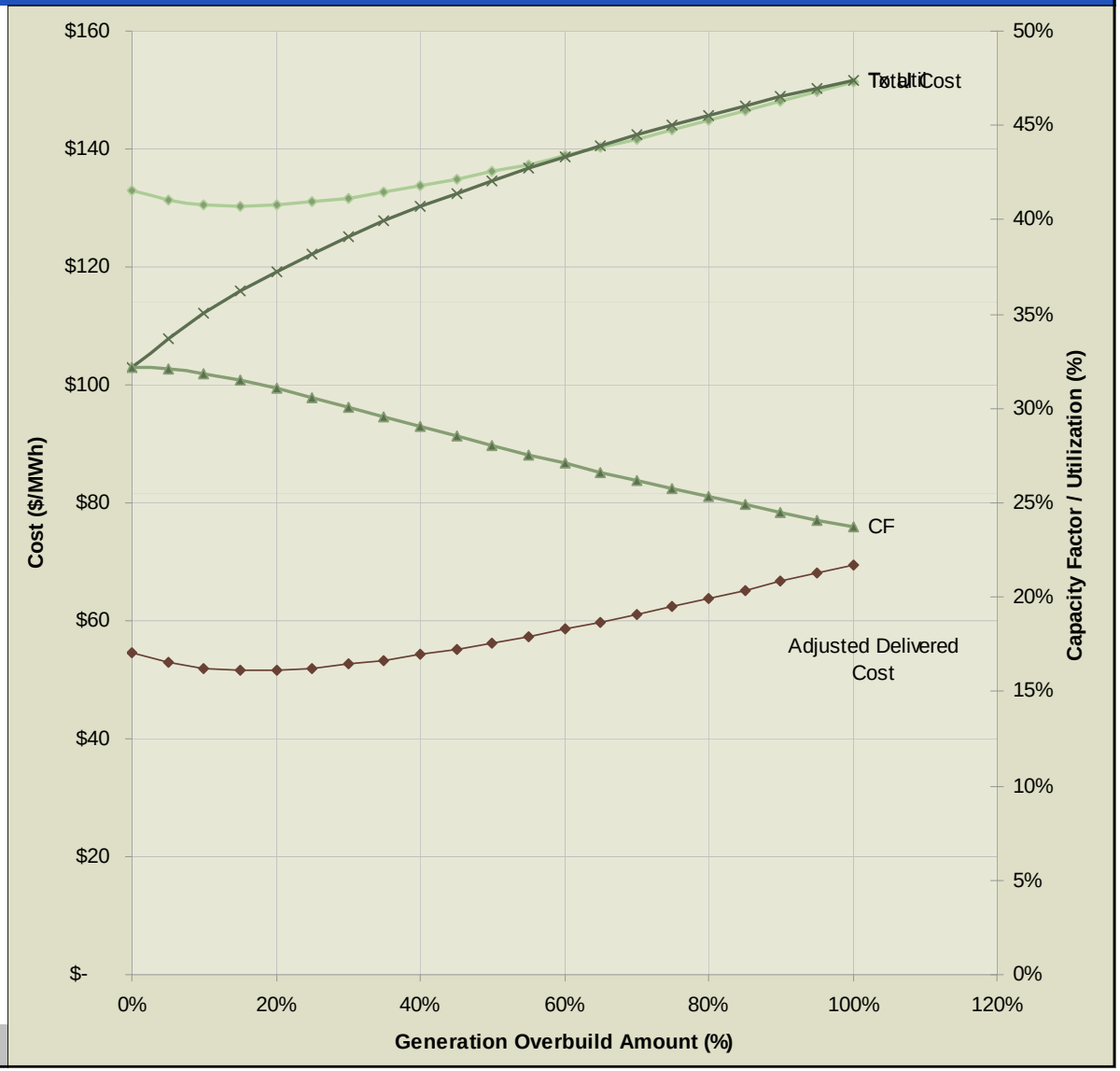
Optimum

Overbuild: 15%

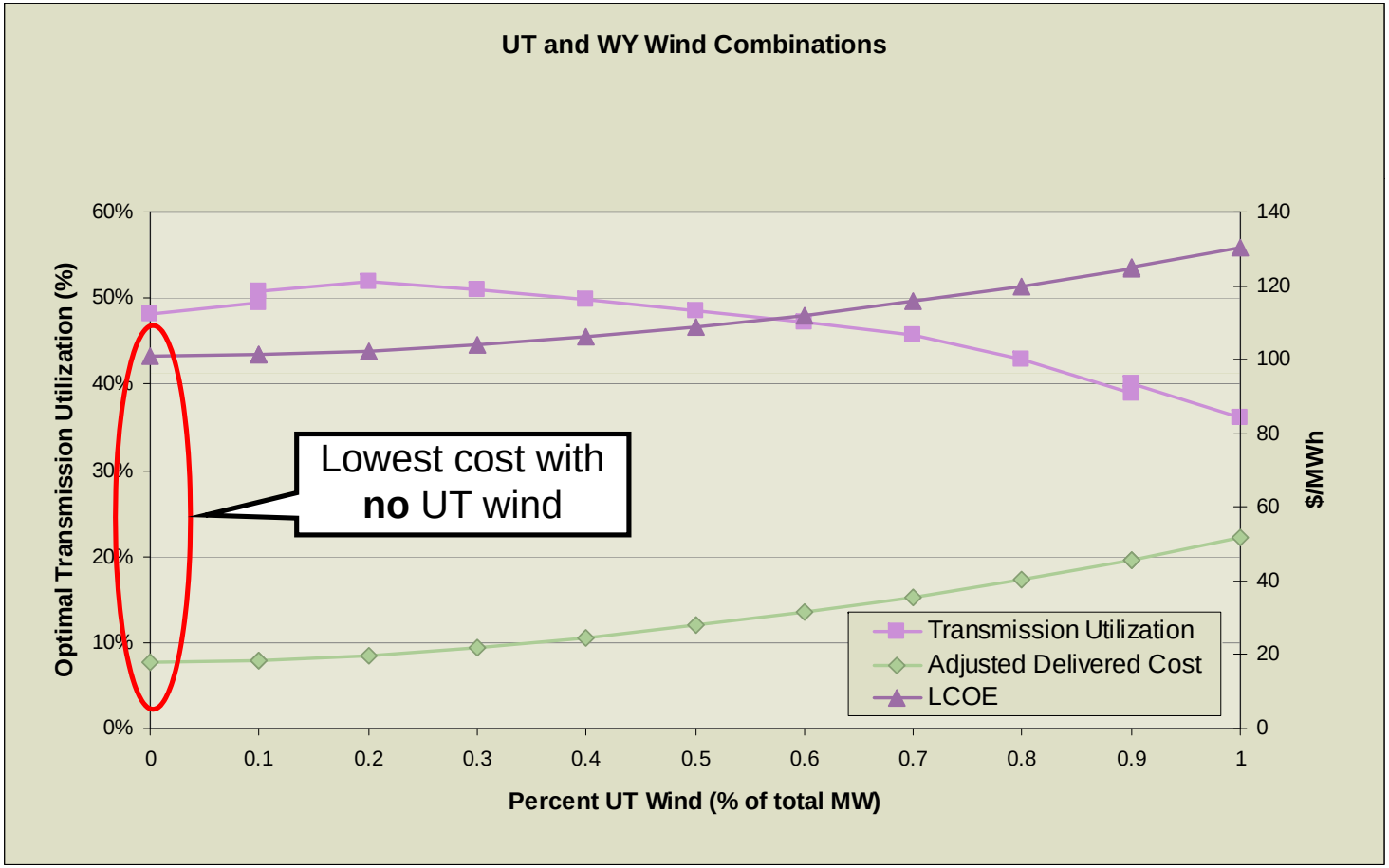
LCOE: $130.24

Adjusted Cost: $51.60

Tx Utilization: 36.2%



Combined UT and WY Wind



BUILDING A WORLD OF DIFFERENCE®

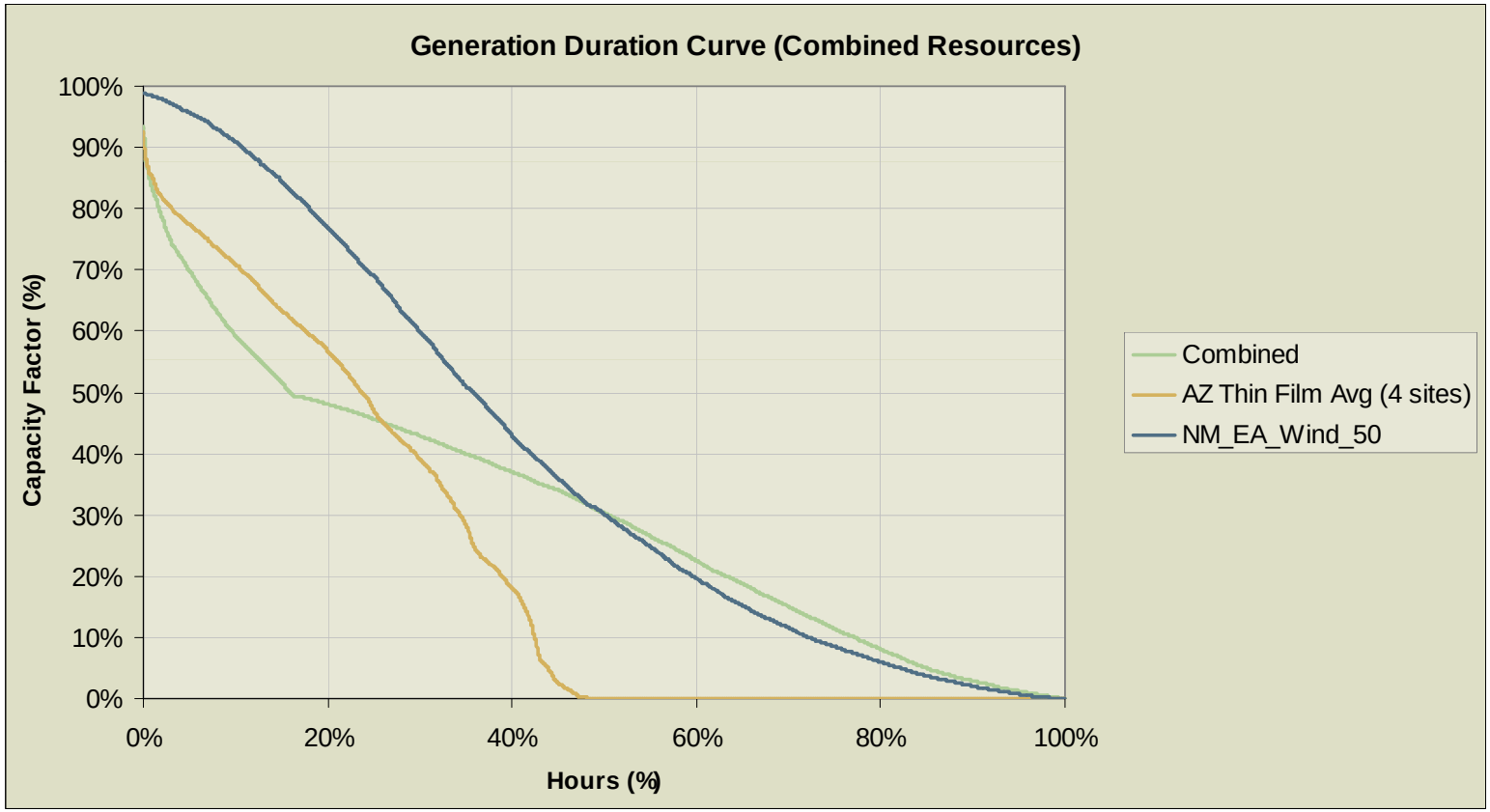
BLACK & VEATCH





Arizona Solar and New Mexico Wind

50% Each – AZ Solar and NM Wind



Arizona Solar

Optima

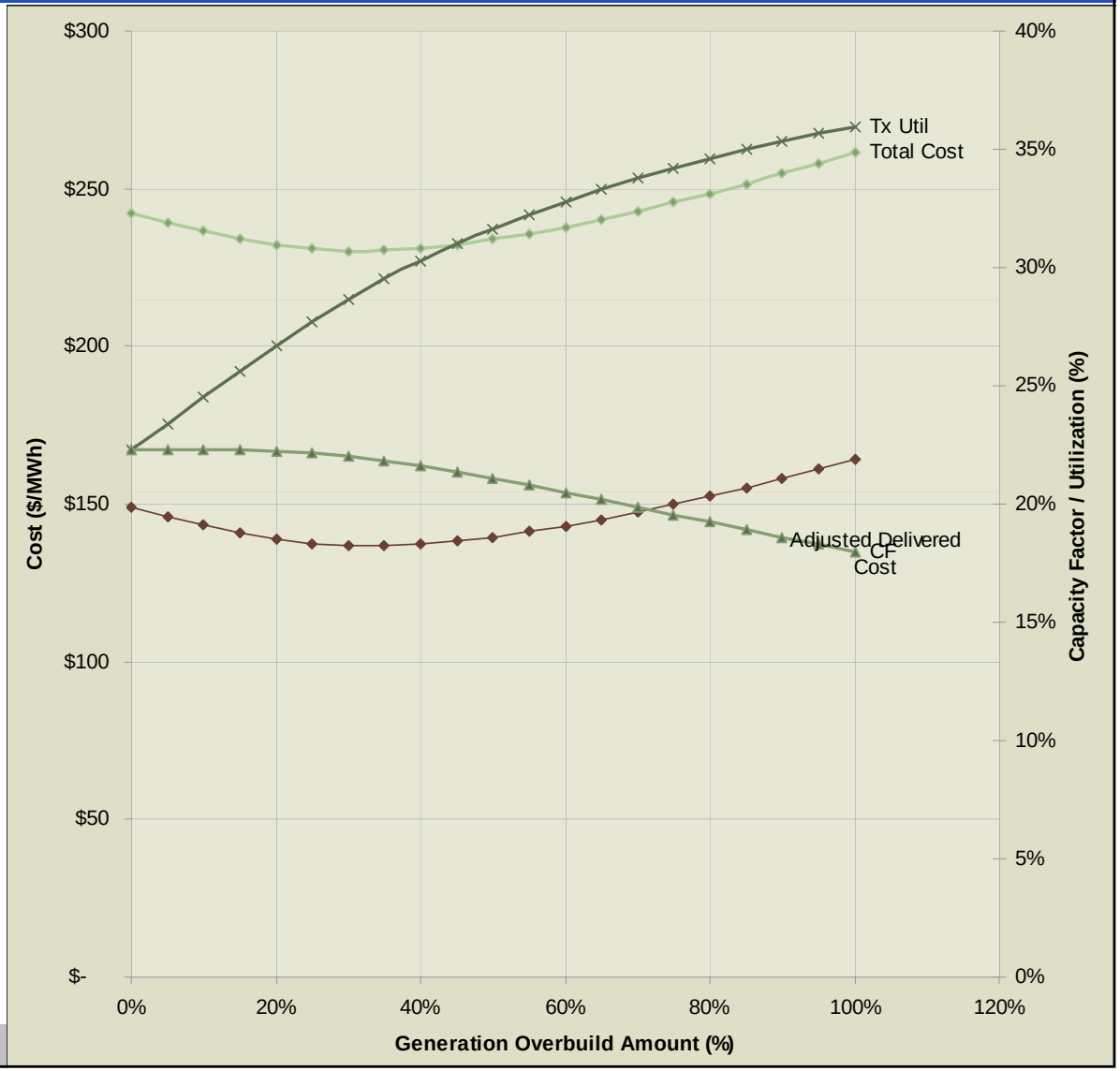
Overbuild: 30% / 35%

LCOE: $230.29

Adjusted Cost: $136.77

Tx Utilization: 28.6% / 29.5%

*Note: Cost-based and value-based analyses produced different optima



New Mexico Wind

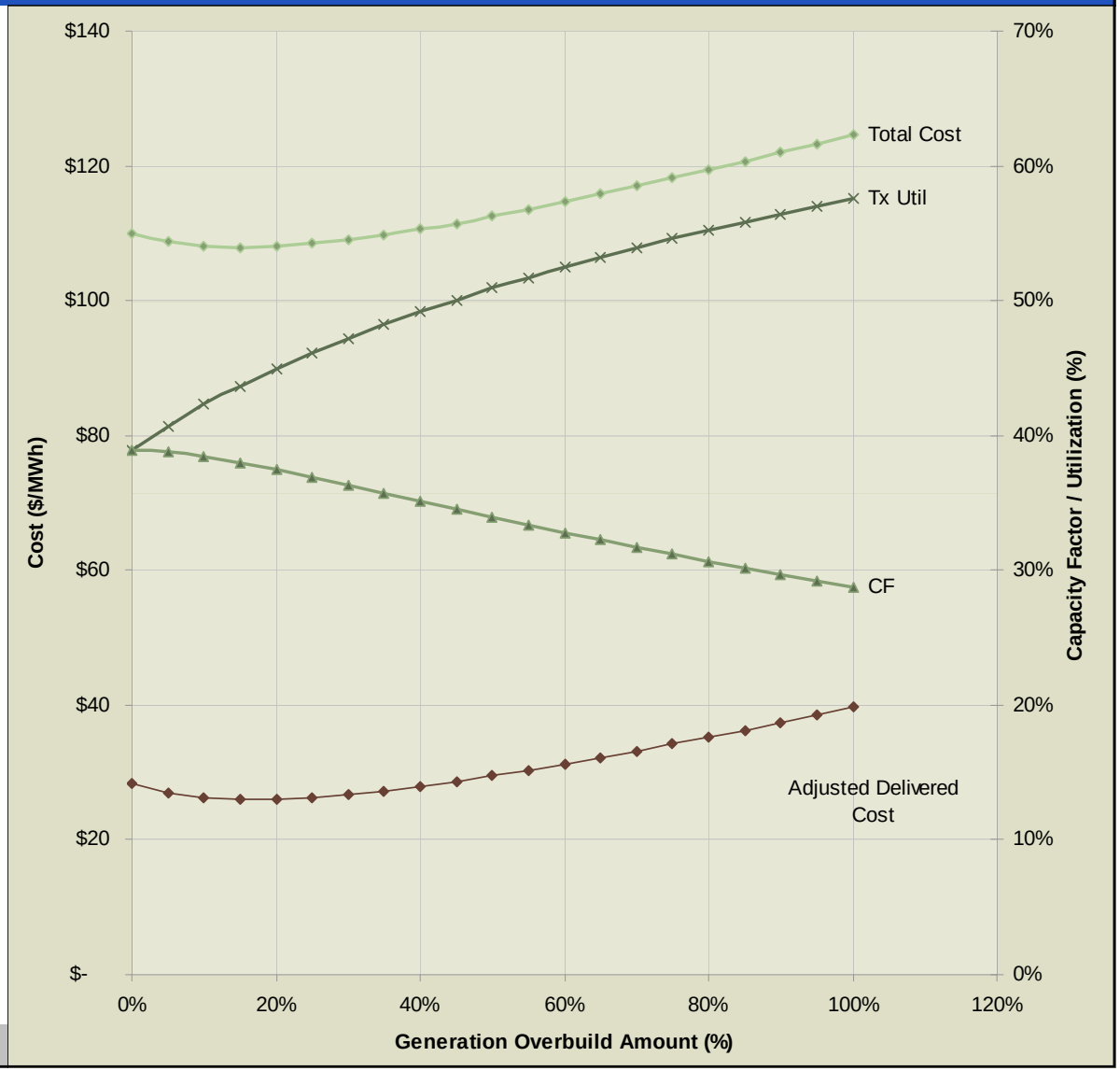
Optimum

Overbuild: 15%

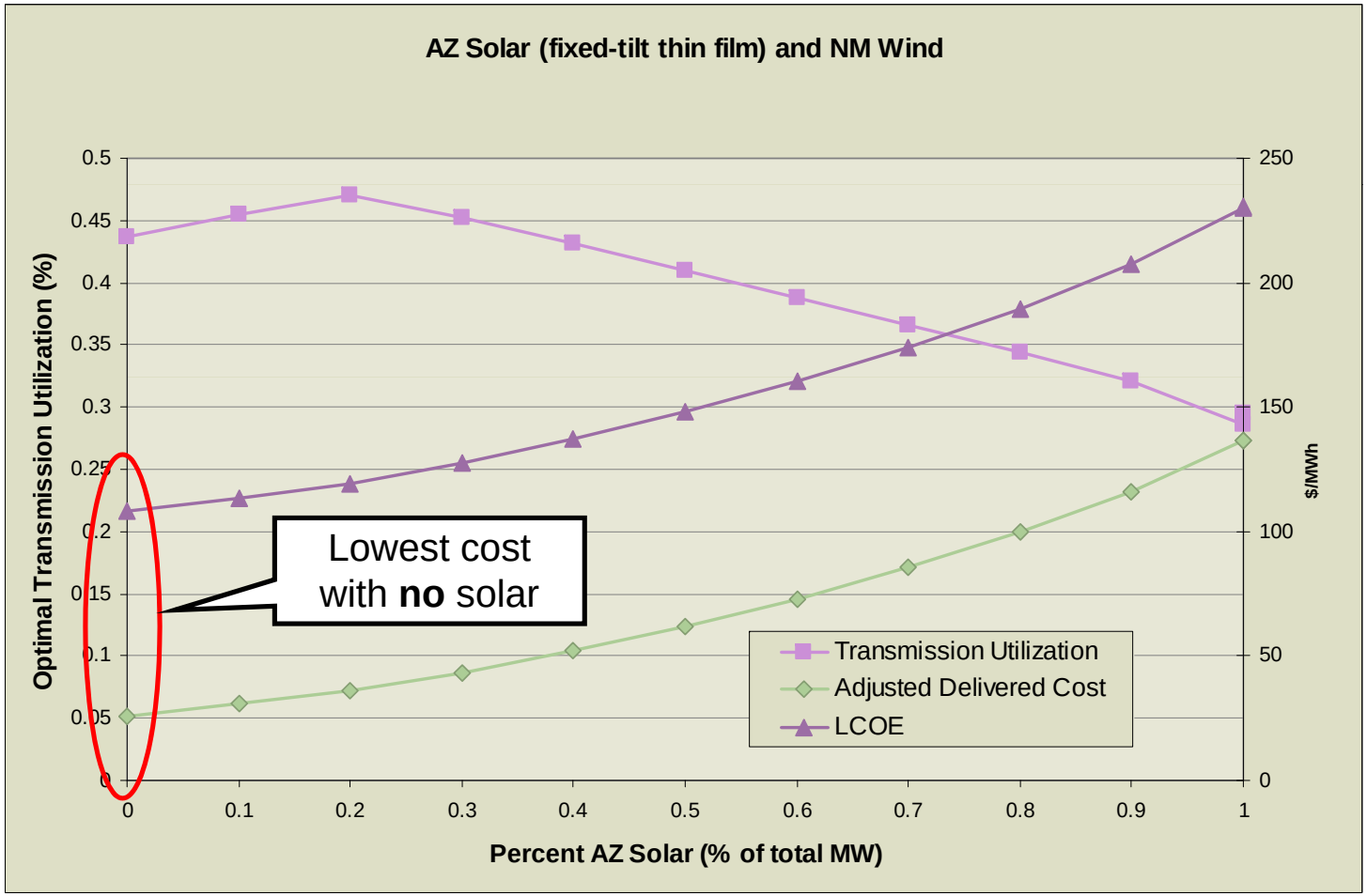
LCOE: $107.93

Adjusted Cost: $26.01

Tx Utilization: 43.7%

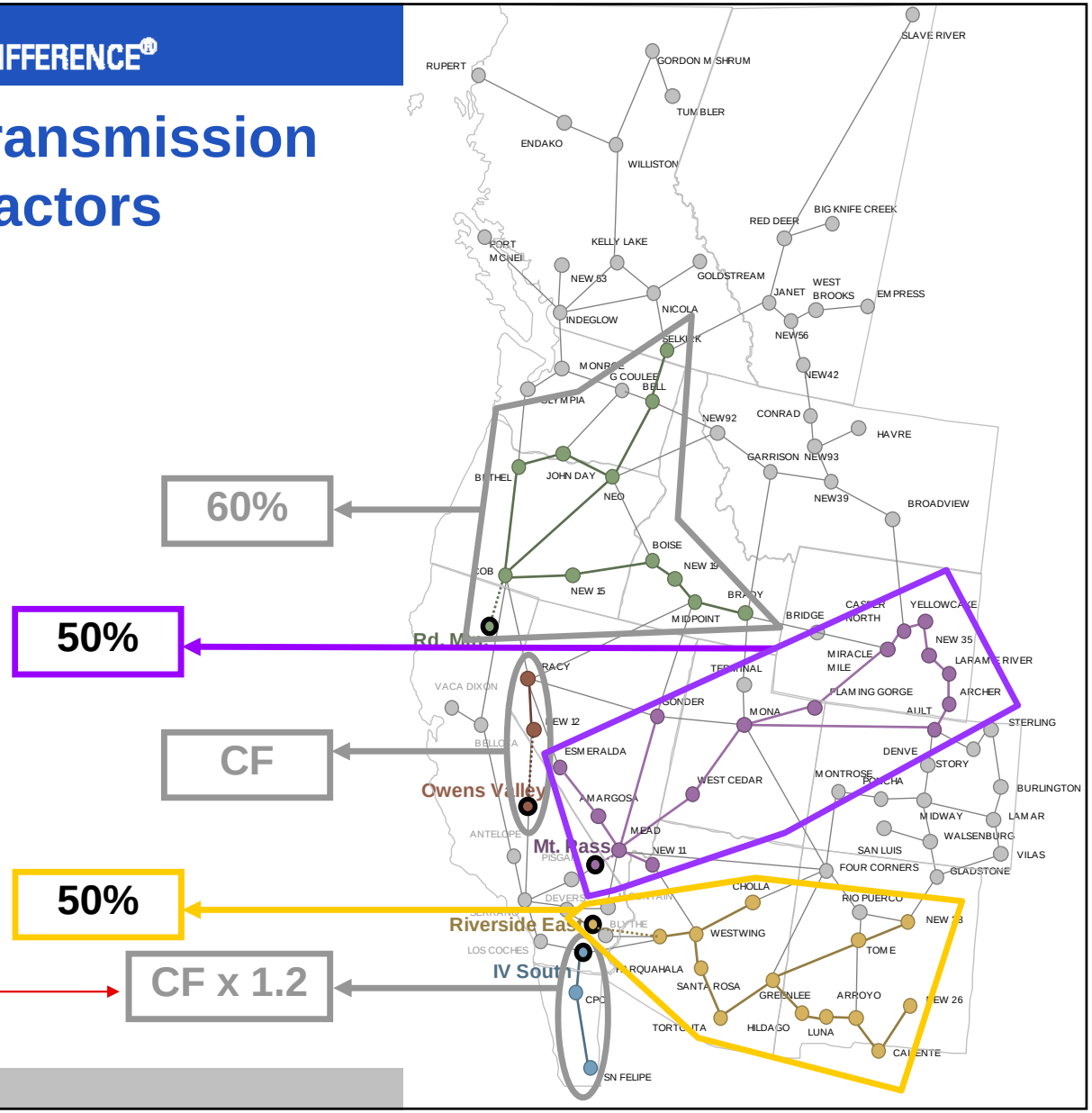


Combined AZ Solar and NM Wind



BUILDING A WORLD OF DIFFERENCE®

Proposed Transmission Utilization Factors



For Baja, the original proposal was to use the resource CF. However, it was discussed that the overbuild principal would apply here also. Further, the line is likely to be privately owned and operated, and developers have an incentive to use dynamic line ratings, which are not employed yet in the U.S. This will allow higher transfer capacity when strong winds present. For these reasons, it is proposed to increase the utilization to 20% greater than the resource CF.